Object's Shape Recognition using Local Binary Patterns

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Abstract—This paper discusses the concept of object's shape identification using local binary pattern technique (LBP). Since LBP is computationally simple it has been utilized successfully for recognition of various objects. LBP which has the potential to be used in various identification related fields was applied on a number of different shaped objects, the process converted the given image in to 3x3 binary matrices and several rounds of computation yields the final decision parameter, which is known as merit function. This parameter was then exploited to uniquely identify the shape of different objects.

Keywords—Local binary patterns; object shape recognition; security technologies; content based recognition

I. Introduction

Today people all around the world are facing a number of challenges related to health, education and specially security. Almost each country of the world is facing different type of threats and indiscipline activities. Because of this unsecure environment and criminal activities hundreds of people are harmed and killed, daily. Terminating, fire, murder and bomb impact are normal exercises nowadays. Security agencies are trying their level best to encounter such types of threats. Object shape recognition is a standout amongst the most difficult and demanding territory of research nowadays. There are numerous applications and research works have been carried out to recognize the shape of objects. Using surveillance camera as a part of open spots, air terminals, lodgings and markets, objects recognition turns out to be more useful technology to maintain a strategic distance from any criminal occurrences in these territories. Object's shape recognition framework required just the shape of any object regardless of various hues, color, size or patterns. Automated computerized object shape recognition is not an easy task.

The proposed work discussed the object's shape recognition system using LBP technique. The object recognition system described in this paper was divided into two modules: Image Registration Module and Image Identification Module. In first module of system, image of an object, whose shape was required to be recognized was captured using a digital camera and image was then stored in computer system database for the purpose of identification and profiling. After filtering, the LBP technique was applied on captured image to produce a merit function to recognized objects. This merit function was stored into system database along with the actual image of an object. In second module the shape of different objects were recognized as shown in Fig. 1.

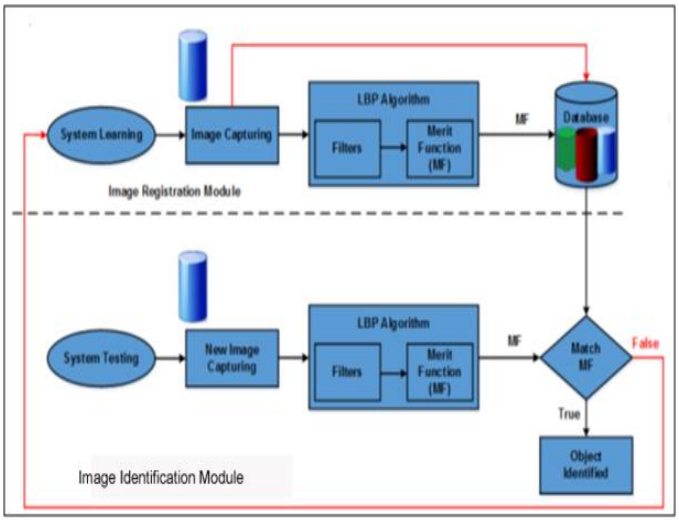


Fig. 1. System modules of proposed work.

Once image was captured, background subtraction technique was applied to extract the object. Using re-sizing method, a captured image was transformed into a standard sized image and then converted into a binary image. Using LBP technique, which was based on image matrix information, a merit function was solved that can be used as a decision parameter to identify the shape of an object. Fig. 2 shows the working of all phases.

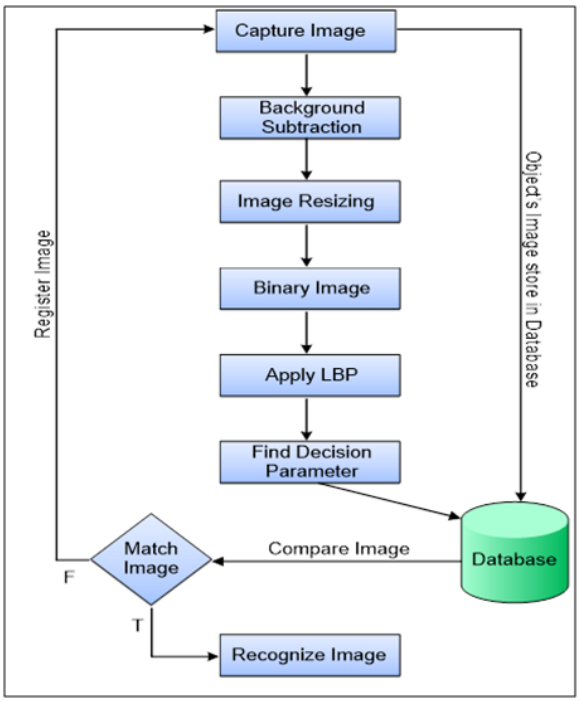


Fig. 2. System working diagram.

II. Local Binary Pattern

LBP technique is very modest and exceptionally productive method for texture cataloging of diverse objects. In this efficient technique of LBP, the binary patterns of object are converted into some equivalent numeric numbers, which can be treated as decision parameter to recognize an object. At initial level this method was discussed a corresponding way to analyze the contrast of pictures. Key embodiment of this technique was set as 8 neighboring pixels, considering the center pixel as core. A mathematical model, which was based on neighbor pixels with respect to center pixel, provided the weights of the network, which was finally totaling the results. In given Fig. 3 the process to calculate merit function (decision parameter) is discussed. For this purpose, a wooden square piece was selected an object. A matrix of order 3×3 was generated in the first step. By applying LBP technique, a merit function was generated, which calculated a value of 112. Same process was applied for other matrices and finally a decision parameter was solved to recognize that object.

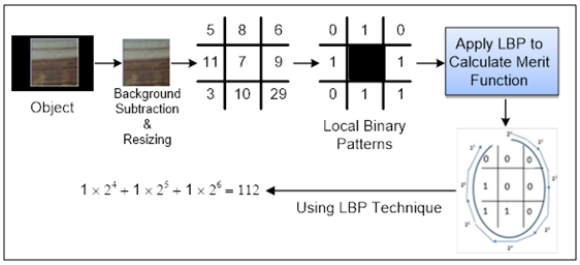


Fig. 3. Calculation of merit function.

A histogram of object's binary pattern also validated the process of verification of different objects. LBP generated various binary codes of different shapes of objects. Using mathematical technique, theses binary patterns converted into decision parameter (a numeric value) for the purpose of recognition. LBP has turned out to be by and large utilized as a part of image processing and computer vision areas because of its high discriminative strength, broadmindedness in contradiction of light variations and computational easiness. Some very common LBP applications are:

- Object's feature extraction to find the nature of shape.
- Textures classification and segmentation of different objects [1].
- Pattern recognition of different objects [2], [3].
- To analyze biomedical images.
- To extract the features of human face for identification [4]-[6].

The LBP technique has the potential to use in many applications with an acceptable accuracy. Its computational complexity to identify shape of different objects is low. This technique has no major impact with pose variation of objects or change in illumination [7], [8]. Logically LBP applications can be classified into two domains — local and global. A global approach of LBP is used to identify the shape of objects and local approach of LBP or the combination of both approaches provided detail information and can be used to recognized human faces.

III. Literature Review

Object recognition is one of the major areas of interest for researcher these days. There are a number of research contributions by the researchers. As for LBP is concerned, this technique is used in variety of applications such as face recognition, lung's cancer detection, prediction of facial age of human, etc.

A bottom-up approach is presented in [9] to identify nature of fascinated objects. To develop an operative and vigorous identification technique, the suggested methodology is accomplished by extracting the features of objects. In [10], authors described an effective way to identify several objects from images by means of a region resemblance identification is offered. In this technique objects are segmented into regions based on identical features. In [11], authors showed an effective technique to identify specific object from an image. The concept is based on a mixture of certain operators (contains a set of conventional parameters). To get the appropriate results, these parameters are required to adjust in a specific order. In [12], a relative learning is presented for two-dimensional and three-dimensional using LBP technique to diagnose lungs cancer from CT scan images. The technique was tested on a number of lungs CT images from "Japan Society of Computer Aided Diagnosis of Medical Images". Authors of [13] presented a method of face retrieval based on LBP technique. The key idea is to identify significant faces from the huge datasets using content based approach instead of metadata. An implementation of a vigorous face detection technique based on Integral-Haar-histograms with Circular-multi-block Local Binary Operator with comparatively better efficiency is presented in [14]. Hierarchical-age-estimation method is proposed in [15], which comprises local and global

information of human faces. LBP technique was used to extract the local facial features of human faces.

IV. Methodology

In this paper, the LBP technique is used to identify the shape of different objects. To achieve this goal a standard object image is first divided into small segments. Using the concept of thresh-holding LBP set an image in 3×3 order matrices. Each matrix generated a specific value, which were stored in another temporary matrix. Same operation was applied to temporary matrix and finally generated a merit function, which returned a constant value. This constant value was changed with respect to different shape of objects and treated as a main source of object recognition. The details of this methodology to calculate merit function of different objects are described in Section VI. A histogram of binary patterns before and after processing was also generated for the purpose of validation [16], as given in Fig. 4.

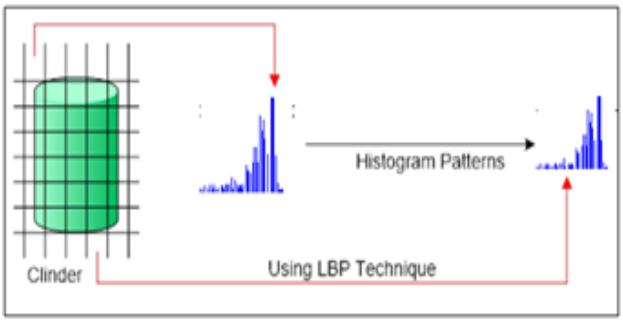


Fig. 4. Histogram of LBP.

This technique may be solved by considering divers neighbor pixel sizes. It depends upon the size of image to select 4, 8 or 16 neighbor pixels patterns for LBP as shown in Fig. 5. Binary patterns values (v) were generated for different patterns, for example $x_1{}^{(i)}$ is the first binary value generated by first neighbor pixel in 16 neighbor pixels patterns. Similarly $x_n{}^{(i)}$ is the last binary value generated by LBP. The basic local binary value using all 16 neighbor pixels can be generated using (1).

$$v = \sum_{k=1}^{i} x_k \quad (1)$$

Where 'i' is the total number of neighbor pixels under study.

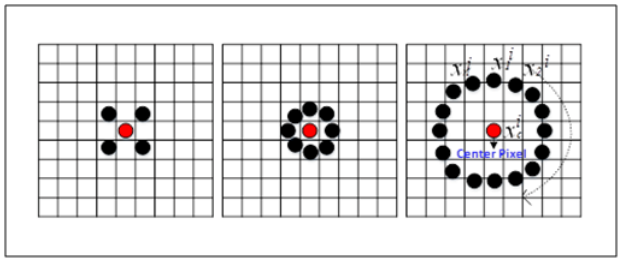


Fig. 5. Neighbor Pixels (4, 8 and 16) in LBP Technique.

The concept of LBP was demonstrated in [17], [18] by hypothesis that a surface consists of two corresponding features — the patterns and its anatomy.

V. Phases and Working of the System

Following are the work example of LBP technique tested in Image Processing Research Lab (IPRL). The LBP technique applied on a number of objects and some of them (Cylinder, sphere, square and triangular wooden objects) are reported here. Fig. 6(a) shows the working of system using LBP technique. Fig. 6(b) described the calculation of merit function along with histogram patterns of cylinder object. In this figure an image of a cylindrical was captured, cropped and then converted into binary image. The LBP technique was applied using 3×3 neighborhood pixels of the image and generated a histogram along with the merit function for object (cylinder). Similarly, the same process was applied on other objects like square, sphere and triangular wooden objects to calculate their merit functions and corresponding histogram patterns, as shown in Fig. 6(b)-(d), respectively.

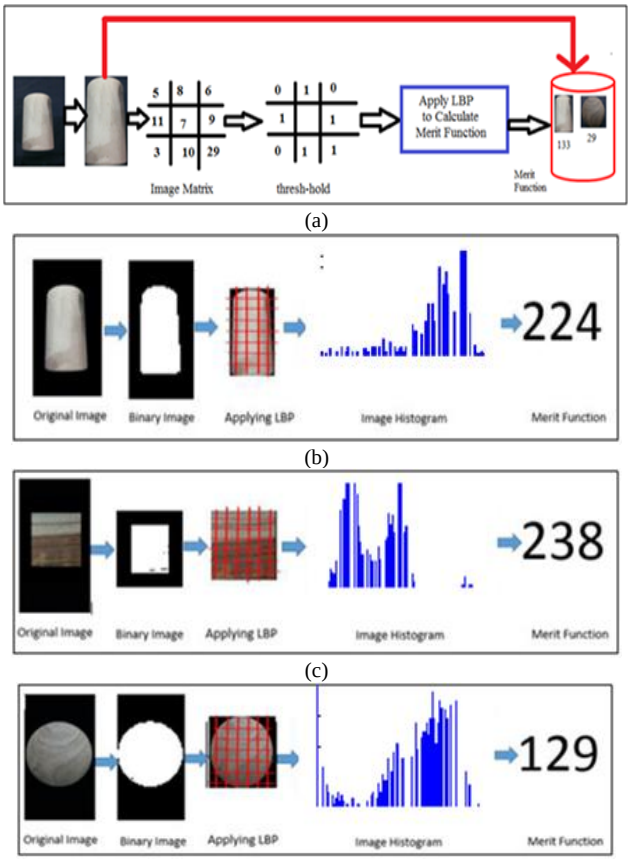


Fig. 6. (a). System working diagram using LBP technique, (b). Generation of merit function for cylinder object, (c). Generation of merit function for square object, (d). Generation of merit function for sphere object

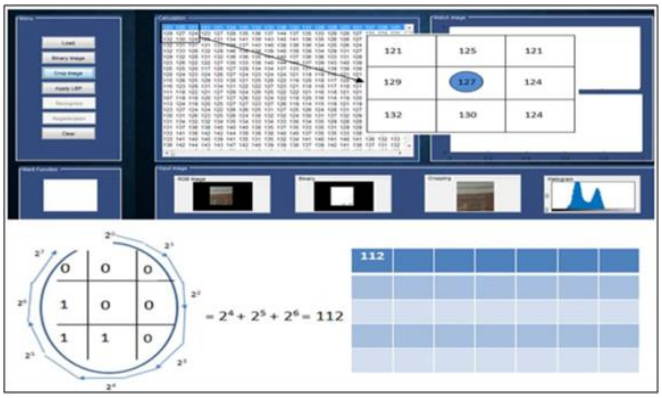
VI. Calculation of Merit Function

At staring the design algorithm first selected a (3×3) matrix from captured image matrix. Then compared the center pixel value of the (3×3) matrix with its neighborhood values and convert the matrix in binary form by describing a condition (threshold); the value that is less than or equals to the center value will be assigned '0' and the greater value will be assigned '1'. The new value can be obtained through the calculation of the binary matrix. The matrix is added in a

clockwise manner by the increasing powers of each code starting from 0 and ranging to 7 by using the formula:

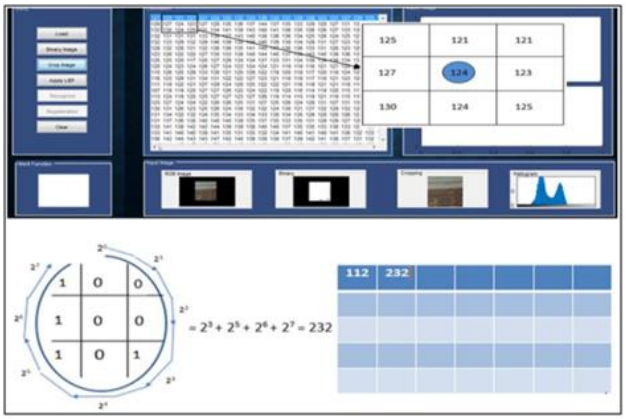
$$x = 20 + 21 + 22 + 23 + 24 + 25 + 26 + 27$$
$$x = 0 + 2 + 0 + 8 + 0 + 0 + 0 + 0$$
$$x = 10$$

Now the calculated value will be inserted into the first index of the new matrix, as shown in Fig. 7(a).



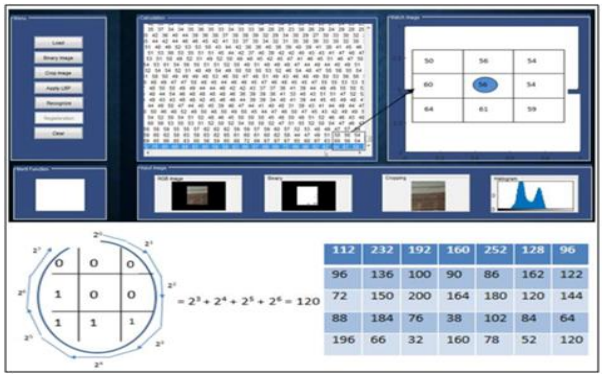
(a)

Then moving towards the second step, shift one index right and apply the same technique as described in the first step, and given in Fig. 7(b).



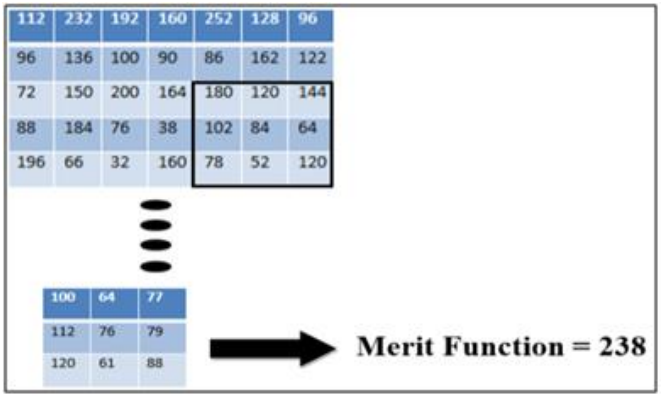
(b)

Continue shifting one by one pixel using same technique for 3 ×3 matrix and stored the value in a designed matrix. A final updated matrix along with all calculated values is shown in Fig. 7(c).



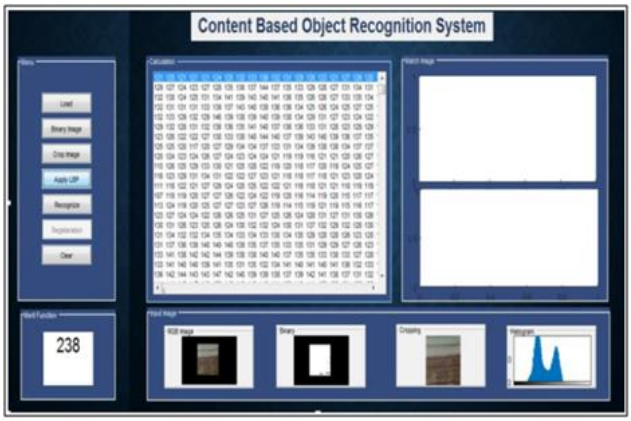
(c)

Now, pick the 3×3 matrix from the updated matrix and apply the same technique and generated new calculated values. Repeated same for all the matrix values and generated a final merit function. This process is shown in Fig. 7(d).



(d)

Based on all calculated values the merit function of the object is used to recognize the objects, as shown in Fig. 7(e).



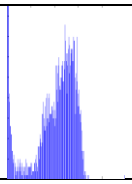
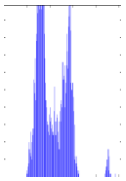
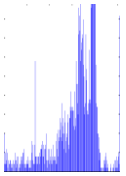
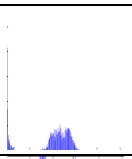
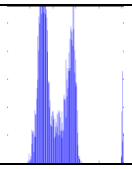
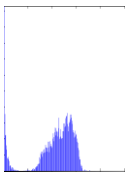
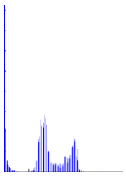
(e)

Fig. 7. (a) First index calculation of LBP Technique, (b) Second index calculation of LBP Technique, (c) Final updated matrix along with all calculated values, (d) Calculation of merit function, (e) Calculate merit function.

VII. Results

The LBP system recognized the objects on the basis of the respective calculated merit function. The system was tested on different objects (sphere, cylinder, square, and triangular). The merit function value based on designed LBP technique was found as: Sphere=129, Square=238, Cylinder=224, Triangle=131, Rectangle=230, Ellipse=210 and Hexagonal=155. The results showed reasonable differences between the merit function values for different objects for the purpose of object's shape recognition. These results are summarized in Table 1 below:

TABLE I. RESULTS OF DIFFERENT OBJECTS

S No	Objects	Image	Merit Function	Histogram
1	Sphere		129	
2	Square		238	
3	Cylinder		224	
4	Triangle		131	
5	Rectangle		230	
6	Ellipse		210	
7	Hexagonal		155	

VIII. CONCLUSION

The object recognition based on LBP method was an operative technique in the domain of security, surveillance, medical and industrial applications. The system based on LBP is very simple and reliable technique to recognize the shape of different objects.

IX. FUTURE WORK

In contents of future direction, this concept of LBP can be used in a number of applications such as to find the face symmetry of human faces, to analyze the back shape symmetry of human body, content based object recognition, etc.

REFERENCES

[1] Wang, L., He, D.C.: Texture classification using texture spectrum. Pattern Recognition. pp. 905–910 (1990).

[2] Mäenpää, T.: The local binary pattern approach to texture analysis—extensions and applications. PhD thesis, Acta Universitatis Ouluensis C 187, University of Oulu (2003).

[3] A. Hadid, T. Ahonen, M. Pietikinen, "Face analysis using local binary patterns" in Handbook of Texture Analysis, U.K., London:Imperial College Press, pp. 347-373, 2008.

[4] T. Ahonen ; A. Hadid ; M. Pietikainen. Face Description with Local Binary Patterns: Application to Face Recognition. IEEE Transactions on Pattern Recognition, 28(12) (2006).

[5] W. Y. Zhao, R. Chellappa, A. Rosenfeld, and P. J. Phillips. Face recognition: A literature Survey. UMD CfAR Technical Report CAR-TR-948, Center for Automation Research, University of Maryland, (2002).

[6] Rahim, Md Abdur, et al. "Face recognition using local binary patterns (LBP)." Global Journal of Computer Science and Technology (2013).

[7] T. Ahonen, A. Hadid & M. Pietikäinen, Face Description with Local Binary Patterns: Application to Face Recognition. Draft, (2006).

[8] T. Ojala, M. Pietikäinen & T. Mäenpaä. Multiresolution gray-scale and rotation invariant texture classification with Local Binary Patterns. IEEE Transactions on Pattern Analysis and Machine Intelligence. 24(7), (2002): 971-987.

[9] Chenini, Hanen. A Bottom-up Approach for Visual Object Recognition on FPGA based Embedded Multiprocessor Architecture. International Journal of Advanced Computer Science and Applications (IJACSA), 8(5) (2017): 474-482.

[10] El Idrissi, Abdellatif, et al. A Multiple-Objects Recognition Method Based on Region Similarity Measures: Application to Roof Extraction from Orthophotoplans. International Journal of Advanced Computer Science and Applications (IJACSA), 6(11) (2015): 292-303.

[11] Qaffou, Issam, Mohamed Sadgal, and Aziz Elfazziki. A New Automatic Method to Adjust Parameters for Object Recognition. arXiv preprint arXiv:1211.6971. International Journal of Advanced Computer Science and Applications (IJACSA), (2012)..

[12] Arai, Kohei, Yeni Herdiyeni, and Hiroshi Okumura. Comparison of 2D and 3D local binary pattern in lung cancer diagnosis. International Journal of Advanced Computer Science and Applications (IJACSA), 3(4) (2012): 89-95.

[13] Khoi, Phan, Lam Huu Thien, and Vo Hoai Viet. Face Retrieval Based On Local Binary Pattern and Its Variants: A Comprehensive Study. International Journal of Advanced Computer Science and Applications (IJACSA), 7(6) (2016): 249-258.

[14] Suri, P. K., and Er Amit Verma. Robust face detection using circular multi block local binary pattern and integral haar features. International Journal of Advanced Computer Science and Applications (IJACSA), Special Issue on Artificial Intelligence (2011).

[15] Günay, Asuman, and Vasif V. Nabiyev. Facial Age Estimation based on Decision Level Fusion of AAM, LBP and Gabor Features. International Journal of Advanced Computer Science and Applications (IJACSA), 6(8) (2015).

[16] Mäenpää, T., Pietikäinen, M.: Texture analysis with local binary patterns. In: Chen, C.H., Wang, P.S.P. (eds.) Handbook of Pattern Recognition and Computer Vision, 3rd ed., World Scientific, Singapore (2005): 197–216.

[17] Ojala, Timo, and Matti Pietikäinen. "Unsupervised texture segmentation using feature distributions." Pattern Recognition 32.3 (1999): 477-486.

[18] Ojala, T., Pietikäinen, M., Harwood, D.: A comparative study of texture measures with Classification based on feature distributions. Pattern Recognit. 29(1), (1996): 51–59.