Detection of forgery in the Libyan currency using digital image processing

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Abstract

The Central Bank of Libya has warned of a circulating counterfeit 50 dinar currency.
The Central Bank said in a statement that it had seized a counterfeit currency of 50 denominations, which differed in its specifications from the category printed in Russia. The Central Bank of Libya called on citizens to be "cautious when dealing with this mentioned currency and to inform the security authorities of any suspicion about it."

In this system, digital image processing was used for the purpose of detecting forgery in the Libyan currency, and the system consists of three stages, the first stage , which is the pre-processing , consisting of (Gray Scale Image , Thresholding) the second stage , Feature Extraction using Gray-level co-occurrence matrices And the third stage Classification using the percentage.

Keywords : image processing , Libyan currency , Gray Scale , Thresholding , Gray-level co-occurrence matrices , percentage.

1. Introduction

The statement of the Central Bank of Libya in Benghazi revealed that the Libyan currency in general has very high security specifications, and it is difficult to counterfeit it the world. Recently, many cases of attempting to counterfeit various denominations such as the 5 dinars, 10, 20 dinars, and 50 dinars have been previously discovered, adding that although the discovery of counterfeit currency is a regular work for the Central Bank, it is the first time that it has been mentioned in the media. This is not justified unless the number of forged papers is many and threatens the economic situation.
there are losses in the overall economy of the country‘s currency value.

The technological advancements have made a pathway for currencies to be duplicated such that it cannot be normally recognized [4]. Advanced printers and new editing computer software's are used to create counterfeit currencies. Fake currencies can just be slipped into bundles of genuine currency which is how they are usually circulated in the market

2. RELATED WORK

In paper [1], presented the advancement of color printing technology, has increased the fake currency note printing rate and duplicate notes on a high scale. In previous days, the printing could be done in a print house, but now anyone can print counterfeit notes by using simple laser printer. As a result the issue of fake notes instead of the original notes has been increased very largely. India unfortunately cursed with the problems like corruption and black money. And counterfeit of currency notes is also a major problem. The proposed system gives an approach to verify the fake notes. Verification of currency, note is done by using image processing. This article describes feature extraction of Indian currency notes. MATLAB software is used to extract the note features. The proposed system has advantages like simplicity and high performance speed. The result will predict whether the currency note is fake or not.

In paper [2], A technique for verifying India paper currency. The approach gives an efficient method of fake currency detection based on physical appearance. The work will surely be very useful for minimizing the counterfeit currency. Through this application, we are able to see the missing parameters which the fake note doesn't have as compared to the original notes. Original Currency being detected using Image Processing Technique. .[3]

The main objective of this paper is fake currency detection using the image processing. Fake currency detection is a process of finding the forgery currency.

After choose the image apply preprocessing. In pre-processing the image to be crop, smooth and adjust. Convert the image into gray color. After conversion apply the image segmentation. The features are extracting using Hu moments and reduce. Finally compare the image into original or forgery using MSE RMSE.[4]

3. Objective research

The research aims to identify the Libyan currency, specifically And its nature, how to issue it, how to deal with it, and photograph it in all its aspects, and then Attempting to reach a legal vision for this currency based on the legal controls and rules for the currency.

4. Research problem

The research problem can be identified by answering the following questions:
What is the truth about the Libyan currency and when did it appear for trading?
What is its nature and properties?
What is the legal vision for the Libyan currency?
And what is the ruling on trading them?

5. Methodology:

The system proposed here works here on the image of the Libyan paper currency under ultraviolet light obtained by it Digital camera. The algorithm applied here is as follows:

1. Acquisition of image of currency note under ultraviolet light by simple digital camera or scanner.
2. Image acquired is RGB image and now is converted to grayscale image and convert to Thresholding.
3. Convert the image to Feature extraction using Gray-level co-occurrence matrices algorithm .
4. The apply the classification stage using the percentage.
5. If the condition is satisfied, then the currency note is said as original otherwise fake.

5.1 System Architecture

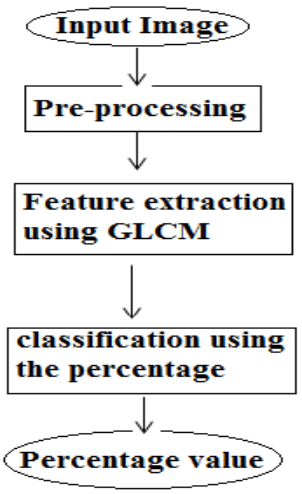

Fig: 1 Block Diagram

5.1.1 Input Image

The image is inserted using digital camera or scanner.

5.1.2 Pre-processing

The phase consists from grayscale and binary image .

5.1.2.1 Grayscale

The image acquired is in RGB color. It is converted into gray scale because it carries only the intensity information which is easy to process instead of processing three Components R (Red), G(Green), B(Blue). To take the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such approach is to take the average of the contribution from each channel: (R+B+C)/3. However, since the perceived brightness is often dominated by the green component, a different, more "human oriented", method is to take a weighted average,

e.g.: 0.3R + 0.59G + 0.11B.

5.1.2.2 Thresholding image

Image analysis often involves the discrimination between "objects" and the background. In general, thresholding can be defined as mapping the grey scale into the binary set {0, 1}: Obtained from gray-level (or color) image g(x, y) by Thresholding. Characteristic Function are

$$B(x,y) = \begin{cases} 1 & IF\ g(x,y) < T \\ 0 & IF\ g(x,y) > T \end{cases}$$

The used algorithm for image Background

Obtaining T automatically

1-Select a value of T.

The choice of the value T range in from 0 to 255 whenever near to zero whenever near to white and whenever neat to 255 whenever near to black choose select value T 128.

2-Segment the image using the obtained T. this will create to groups of pixels. G_1 with all pixels with values <= T, and G_2 with all pixel with values >T.

3-Compute the average for the two regions G_1 and G2

4-Compute the new threshold

5.1.2 Feature extraction Using Gray-level co-occurrence Matrices Algorithm.

GLCM is a statistical method of examining texture that considers the spatial relationship of pixels is the Gray Level Co-occurrence Matrix (GLCM), also known as the gray-level spatial dependence matrix. A GLCM is a matrix where the number of rows and columns is equal to the number of gray levels, G, in the image.
Horlick has extracted many properties or features from GLCM. The gray Comtrex function in MATLAB creates a gray-level co-occurrence matrix (GLCM) by calculating how often a pixel with the intensity (gray-level) value i occurs in a specific spatial relationship to a pixel with the value j. Grey Level Cooccurence Matrix can be defined as:

$$C_{\Delta x,\Delta y,}(i,j) = \sum_{p=1}^{n}\sum_{q=1}^{m} \begin{matrix} 1 & if\ I(p,q) = i\ and\ I(p+\Delta x, q+\Delta y) = j \\ 0 & therwise \end{matrix}$$

Where m and n are grey levels normally m=n for symmetry GLCM. The basic GLCM algorithm is as follow:
1. Count all pairs of pixels in which the first pixel has a value i, and its matching pair displaced from the first pixel by d has a value of j.
2. This count is entered in the its row and column of the matrix Pd[i,j] .
3. Note that Pd[i,j] is not symmetric, since the number of pairs of pixels having gray levels[i,j]does not necessarily equal the number of pixel pairs having gray levels [j,i].
4. The elements of Pd[i, j] can be normalized by dividing each entry by the total number of pixel pairs.
5. Normalized GLCM N[i, j], defined by:

$$N[I,J] = \frac{P[I,J]}{\sum_I \sum_J P[I,J]}$$

The Following GLCM features are extracted in this research work:

- Contrast
- Correlation
- Homogeneity
- Energy

i) Contrast

Contrast is defined as the separation between the darkest and brightest area. It is the difference between the highest and the lowest values of a contiguous set of pixels.

$$\text{Contrast} = \sum_{i,j=0}^{n-1} p_{i,j}\,(i-j)^2$$

ii) Correlation

Correlation is a measure of gray tone linear-dependencies in the image; in particular, the direction under investigation is the same as vector displacement.

$$\text{Correlation} = \sum_{i,j=0}^{n-1} p_{i,j}\,\frac{(i-u)(j-u)}{\sigma^2}$$

iii) Homogeneity

Homogeneity gives information about how little change there is in an image. Homogeneity is defined as the quality or state of being homogeneous.

$$\text{Homogeneity} = \sum_{i,j=0}^{n-1} \frac{p_{i,j}}{1+(i-j)^2}$$

iv) Energy

Energy parameter is also called as Uniformity**.** Energy is a feature that measures the smoothness of the image.

Energy=$\sum_{i,j=0}^{N-1}(P_{i,j})^2$

Algorithm: For calculating GLCM measures for each pixel:

1. Read the input image.
2. Convert the data type to double and Zero pad the image
3. Extract a 3×3 window image from the input image
and compute the co-occurrence texture measure
4. Estimate the texture parameters for the obtained texture image
5. Repeat the step3 and step4 by moving the window till the end of the image
6. Display various texture parameters by normalizing them

5.1.3 classification stage using the percentage

The After the feature extraction Stat comes the classification Stat using percentage , At this stat , the use a set of the image of the original Libyan currency, divided by the image that we want to verify, multiplied by 100.

The block diagram shows steps.

The flow chart of the system classification is shown in Figure 2.

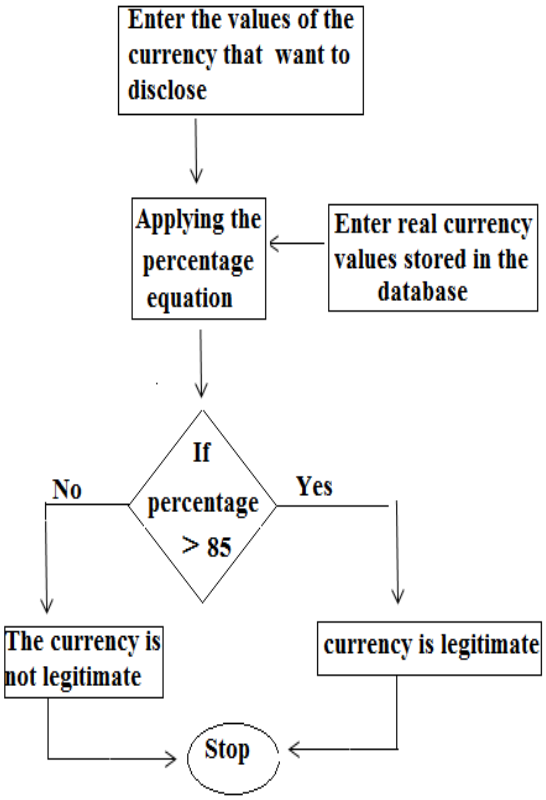

Fig 2 step classification using percentage

6.Result

1. The following figure shows the general interface of the program

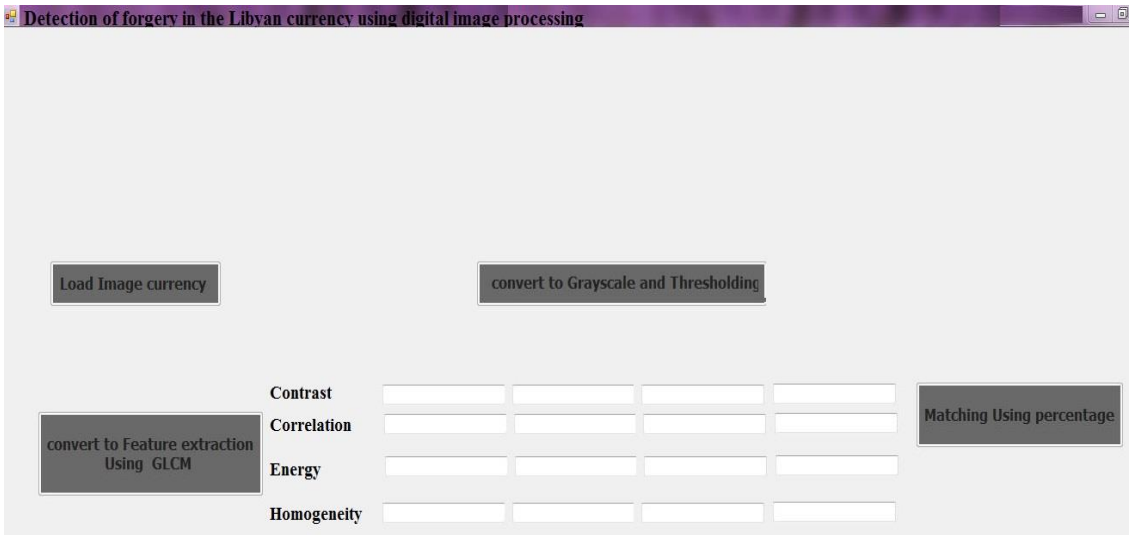

Fig. 1 The overall look of the system

2. The following figure shows the analysis of the Libyan currency of fifty dinars category

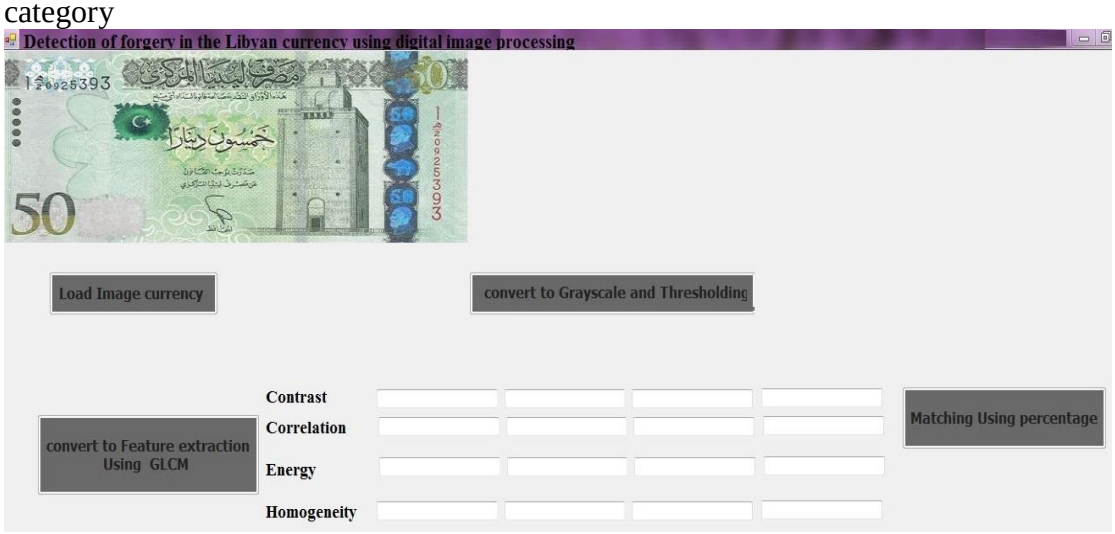

Fig. 2 load the Libyan currency

3. convert image currency to pre-processing using Grayscale and Thresholding image

Fig. 3 Explanation step pre-processing

3. convert pre-processing to Feature extraction Using Gray-level co-occurrence Matrices Algorithm

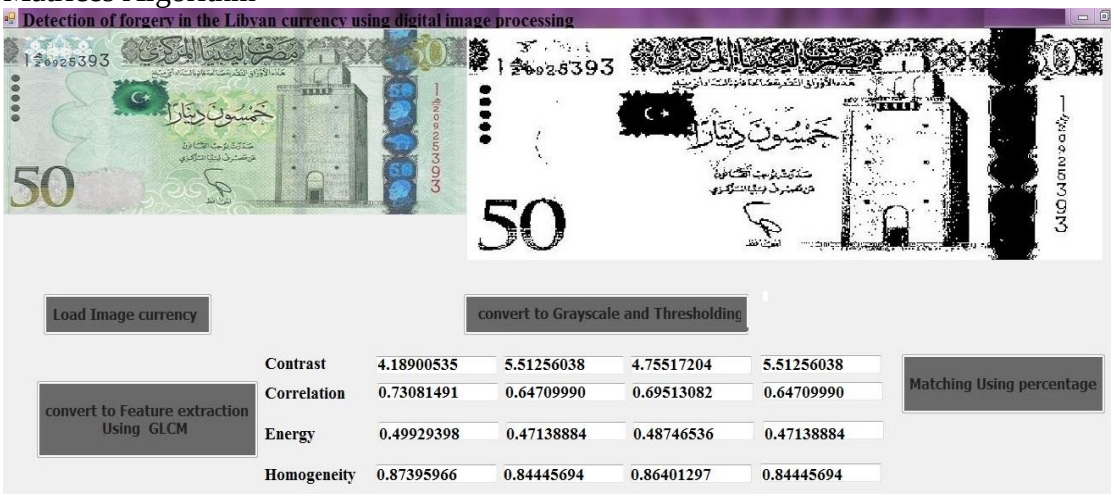

Fig. 4 Explanation step Feature extraction

4. The next view shows the percentage

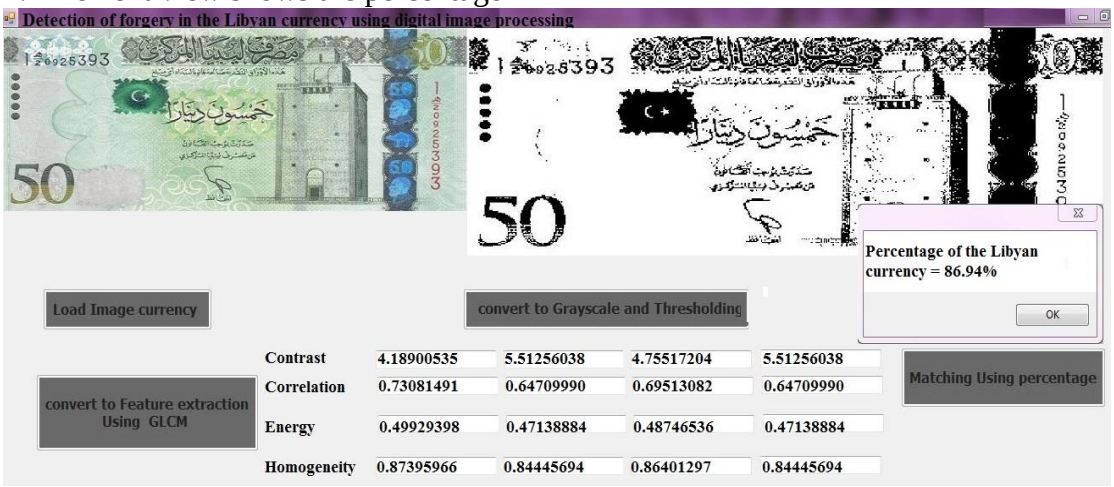

Fig. 5 Explanation step classification stage using the percentage

7. Software, Hardware:

7.1 Hardware Requirement:

1. Hard disk: 500GB
2. Ram: 4 GB

7.2 Software Requirements:

1. Operating system: Windows 10
2. Visual Basic. net 215
3. SQL 2015

Conclusion

In this system, the denomination of fifty dinars of the Libyan currency was used, because most of the forgeries in this paper.

The system was successfully tested from the Libyan currency, with a percentage of more than 88%. Therefore GLCM algorithm is successful method for Libyan currency

Reference

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