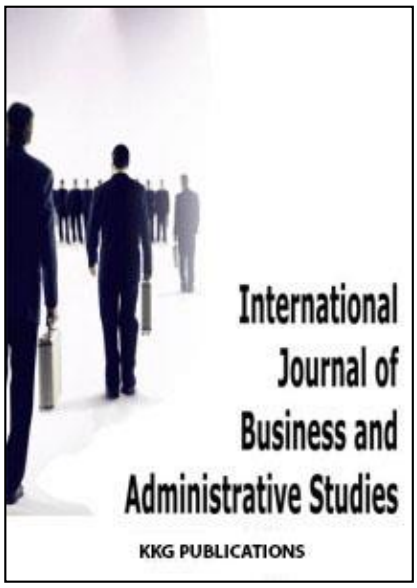

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IRAQI CURRENCY RECOGNITION SYSTEM USING RGB AND HSV COLOR AVERAGE

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Keywords:
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Accurate Results

Abstract. This paper proposed a method to recognize Iraqi currency by computing the average of each color (RGB) for each currency paper. The average of the color will compare with a database that already has been stored in the system. This database includes the average color of each currency. The comparison will use the correlation to find the minimum error. To improve the system and get more accurate results, the color system will convert to HSV system and use the same steps that applied to the RGB color system. Compare the result that we got from two color system to take the last decision. Matlab environment 2011a has been used in this system.

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INTRODUCTION

The currency recognition system uses to recognize the currency paper automatically and find out the class of currency paper. There are many applications of this system; this system can be used in hotels, banks, shops and ATM machine (Debnath, Ahmed & Shahjahan, 2010; Abbasi, 2014). This system deals with different currency paper those take different courses the system has to deals with different directions of currency and has to recognize both sides of currency front and back (Grijalva, Rodríguez, Larco & Orozco, 2010). This system can save the time by helping the employees by reducing the effort that need for counting the money, for this, the system has to recognize the currency fast and correctly. The system depends on different properties when it deals with the currency, this property can be color, size and characters and text on a currency paper (Yaseri & Anisheh, 2013). Different currencies have different currency papers, each one of these papers has its own properties. Many researches proposed different methods to design a currency recognition system in different countries. (Abbasi, 2014; Kumar & Aggarwal, 2012; Siewer, Murray & Dias, 2001; Lamont, Cervantes, López & Rodríguez, 2013). Some of this currency are old and have noise then some methods and technical need to process these cases to get more accurate results. Image processing techniques have been used to remove the noise to make the currency more clear. Filters like median and average filters have been used for this purpose. Some of the edge detection filters like sobel filter has been used to recognize some characters on currency paper. Image segmentations used in some methods to crop the area that will use for recognition. Neural network and pattern matching are used to find out the class of currency (Jain & Vijay, 2013; Yadav, Patil, Karhe & Patil, 2014).

Then the digital image processing technique has been used to re-process the currency. The color is one of the digital image components. This paper will suggest a method that deals with color of image to recognize the currency papers.

RELATED WORK

Georgia, Ali and Mukherjee (2015) proposed a novel method for detection and recognition of Indian Currencies. By using a computer Vision approach, color, aspect ratio and the Unique identification mark were extracted. And based on the algorithm developed the currencies were correctly classified with a success rate of approximately 97%. The processing time taken is 2.52 seconds. The recognition is invariant to image rotation as they have employed Fourier Descriptors for feature extraction of unique I.D. Mark.. This paper describes three different types of distortions, namely translations of 1or2 pixels and turns for the motions of scaling and rotations, which are applied to the training data either before or during the training process. The results demonstrate that almost all the classifiers and CNN train able features could evidently

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benefit from the distortions, especially, recognition accuracy of CNN increases more than 0.5%. they also discover that the translations provide a closer simulation of the variances among the test data set, and produce a higher recognition rate than scaling and rotations. Mirza and Vinti (2012) proposed technic to verify the Indian currency according to the different part and simple of currency paper the part are security thread, identification mark, watermark and latent image. This system converts the image to grey scales before using the segmentation of the characters (Yaseri & Anisheh, 2013). In this work new method use Fourier- Mellin transform and SVM has been proposed. The result showed that there is a high accuracy in currency paper recognition. This method performed in 23 different countries banknote denomination, indicate that methods has 98.7% of accuracy (Pawade, Chaudhari & Sonkamble, 2013) Proposed method that uses the ensemble neural network for currency recognition. In these methods each neural network in ensemble neural network trained independently. (Pawar & Kale, 2012) proposed methods for currency recognition that convert the image from RGB system to HSV system before the process. The purpose of using HSV because it is close to human conceptual understanding of color

Iraqi Currency

The currency papers of Iraq have been classified into seven classes, each one of these papers has its own color the currency start from 50 Dinar to 25000 Dinar the classes are:

1- 50 Dinar (main color is Purple).
2- 250 dinars (main color is Blue)
3- 500 Dinar (main color is Bluish-Green)
4- 1,000 Dinar (main color is Brown)
5- 5,000 Dinar(main color is Dark blue)
6- 10,000 Dinar (main color is Green)
7- 25,000 Dinar (main color is Red)

FIGURE 1
Iraqi Currency 250 Dinar

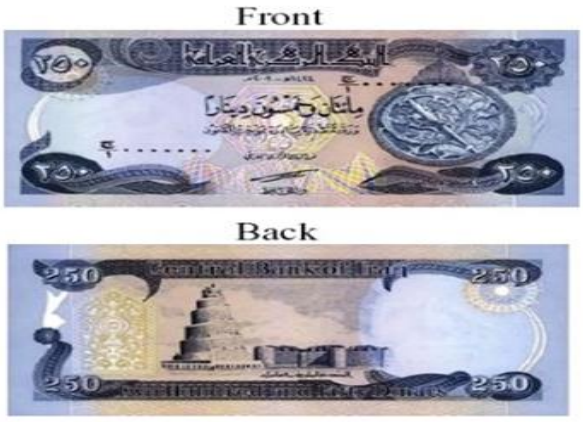

FIGURE 2
Iraqi currency 50 Dinar

FIGURE 3
Iraqi Currency 1000 Dinar

Front

Back

FIGURE 4
Iraqi Currency 500 Dinar

Front

Back

FIGURE 5
Iraqi Currency 5000 Dinar

Front

Back

FIGURE 6
Iraqi Currency 10000 Dinar

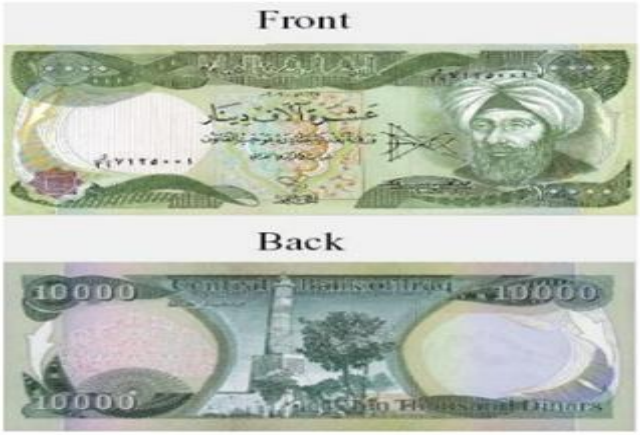

FIGURE 7
Iraqi Currency 25000 Dinar

Image Color Space

The digital image is a combination of three colors Red, Green and Blue. The electronic signal of these three colors denotes as color space. The other color space that commonly uses in image processing is HSI color space. The other color space is HSV it is similar to HSI but the different is (v) denote to the maximum value of RGB components. HSV is commonly used in computer graphics. H (hue) is donated to the color the S () refers to the percentage of the white color that adds to the pure image and v (value) refers to the light intensity. HSV color space it is close color space to human conceptual understanding of color. Converting between color space is needed to use good color space for different applications and chose the suit color space for the specific purpose (Pawar & Kale, 2012).

Similarity of Image According to the Color

The image similarity depends on the color used by different researchers. (Kekre, Thepade & Maloo, 2010) use HAAR wavelet pyramid base on CBIR. They used very HAAR and color HAAR to find the similarity of the image (Kodituwakku & Selvarajah, 2010) compares four features that use the color to find the similarity of images the features are (color moments (CM), color coherent vector (CCV). global color histogram (GCH), local color histogram) all of these methods use the color to find the similarity of images (Jaswal, Kaul & Parmar, 2012) find the similarity of the image by using two color spaces. Six steps have been applied for both color spaces to get the similarity of images. (Kumar, Rao, Rao & Krishna, 2009) used to integrate histogram Bin matches to find the similarity of the image (Chary, Lakshmi & Sunitha, 2012) found the similarity of images based on color projection and many mathematical approach average and standard deviation these mathematical approaches found for RGB color space (Roy & Mukherjee, 2013) used the low level of color feature like histogram, coherence vector. After this step, the author used the edge detection to get better output (Gowri, 2012) find the similarity of image by finding the histogram of RGB

color, then K-mean is utilized to cluster image into multiple classes HSV histogram is found and chi square used to find the similarity of the image (Banga & Dadwal, 2012) uses RGB color space to estimate Ripeness level base on image similarity.

PROPOSED SYSTEM

Prepare the Database

The idea of this system is that the current image is input to system in digital format by using a scanner and compare with the current image in the database. The database that uses it has to be prepared well and the images that store, it has to take different classes and cover all the currency paper classes. The database should include images for all Iraqi currency paper for six classes (250, 500, 1000, 5000, 10,000, 25000) and takes different cases like different amount of noise for each class and old and new currency image for each class.

Finding the Average of Each Color Space

The digital image uses the RGB color model, in this model each color, is mixed from three values R, G and B the amount of these colors make up the final value of each pixel in the image. The digital image is included, three matrix one matrix for each color, the change of the value of any color lead to change the of the color of the pixel. The system calculates the average of each color in each currency.

$$Mean(Red) = \frac{\sum Values\ of\ red\ color\ of\ pixels}{total\ number\ of\ the\ pixels\ of\ image}$$

$$Mean(Green) = \frac{\sum Values\ of\ green\ color\ of\ pixels}{total\ number\ of\ the\ pixels\ of\ image}$$

$$Mean(Blue) = \frac{\sum Values\ of\ blue\ color\ of\ pixels}{total\ number\ of\ the\ pixels\ of\ image}$$

HSV model more intuitive method of describing colors, and as the intensity is independent of the Color information, this is a very useful model for image processing.

Hue(H) : The _true colour_ attribute (red, green, blue, orange, yellow, and so on).

Saturation: The amount by which the colour as been diluted with white. The more white in the colour, the lower the saturation. So a deep red has high saturation, and a light red (a pinkish colour) has low saturation.

Value: The degree of brightness: a well-lit color has high intensity; a dark color has low

Intensity.

The digital image is store in RGB model the image can convert to HSV model

V=max[R,G,B]

£=V-Min[R G B]

$$S = \frac{£}{V}$$

Now calculate the value of Hue for the pixel

If V=R $\quad H = \frac{1}{6}\frac{G-B}{£}$

If V=G $\quad H = \frac{1}{6}(2 + \frac{G-B}{£})$

If V=B $\quad H = \frac{1}{6}(4 + \frac{G-B}{£})$

The values of two color space calculate for the input image and each image in database. The system find the values and put in two array one array(array1) for the input image color space value the second array for the database image.

The Values of Array 1 and Array 2

Mean (R)	Mean (G)	Mean (B)	Mean (RG)	Mean (RB)	Mean (GB)	Mean (RGB)	Mean (H)	Mean (S)	Mean (V)	Mean (HS)	Mean (HV)	Mean (VS)	Mean (HSV)

Finding the Similarity of Matrix

There are two matrixes in this system one for the input image, other for the database image the input image matrix will not change. The database image matrix will change as the number of images that store in the database because the input image will compare with all database images. The system has to find which matrix that gets from the database images is closer to matrix that gets from the input image.

The correlation is used to find the similarity between two matrixes (Abdul Latef, 2012) (Ahmed & Nordin, 2011) whenever the value of correlation increase that mean the similarity increase. The database image matrix that gets the highest correlation value mean it represents closer to the input image and it the class of the input currency image.

Algorithm of Proposed System

1. Read the input image
2. Find the mean of R,G,B,RG,RB,BG,RGB
3. Convert the input image to HSV
4. Calculate the mean of H,S,V,HS,HV,SV,HSV
5. Save all the value get from steps 2,4 in matrix (m1)
6. Read image from database
7. Do steps 2,3,4 for database image
8. Save all results get from step 7 in matrix(m2)
9. Calculate the correlation between (m1,m2)
10. Save the value of correlation with the name of database image
11. Do the steps from 6 to 10 for all database image
12. Find the largest value of correlation
13. The database image gave the largest value of correlation represent the class of input currency image

EXPERIMENTS AND RESULTS

The system developed to classify Iraqi currency paper, under Iraqi currency classes categories. Table 1 show the number of input image for each currency paper, the number of paper recognize successfully, and the percentage of success.

TABLE 1
The Number of Input Image and the Percentage of Successful

Currency class	Number of input images	number of paper recognize successfully	number of paper cannot recognize successfully	Percentage of success
25000	50	48	2	96%
10000	50	46	4	92%
5000	50	46	4	92%
1000	50	49	1	98%
500	50	45	5	90%
250	50	47	3	94%

But in some cases these ranges do not give accurate results. Because some of the currency paper is damages some of them has a lot of noise, the similarity of color between the currency class of 10,000 and currency class 500 the other similarity between the currency paper class 5000 and currency paper class 250.

CONCLUSION

In this paper, proposed algorithm that can recognize the Iraqi currency based on RGB color space and HSV color space. This system can recognize the currency successfully in high percentage. Some of currency paper cannot recognize successfully because it has a lot of noise or the similarity of color between the currency paper like (10,000 and 500) and (5000 and 250) The system can give better output if the amount of the database images increase and take different cases of currency paper that take the new currency old currency and currency that carries different amount of noise but this increase the run time. The system can be improved by taking more averages like mode and median. Also the system can be improved if taking the other properties like size.

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— This article does not have any appendix. —