Classification of Ancient Coin using Artificial Neural Network

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ABSTRACT
Use of the coins has been started in Asia Minor during 7th century B.C. Dates back between 2500 B.C and 1700 B.C. Coins were used to trade in the Indus valley of Mohenjo-Daro and Harappa. Ancient coins are always tough to identify and recognize. Weathering and other natural causes degrades it overall structure. Classification of such ancient coins using computer vision and machine intelligence is a challenging task. Here in this paper this task has been taken to be addressed. This paper aims to develop a intelligent system which can classify and recognize ancient coins through their images only. The approach involves feature extraction classification and recognition. Standard deviation of the histogram of the image has been considered as a feature which is then classified and recognized by feed forward back propagation artificial neural network. Preprocessing of the image includes filtering of the image for better results.

General Terms
Image processing, Artificial Intelligence.

Keywords
Ancient coin, Digital image processing, Histogram, Standard deviation, feed forward back propagation artificial neural network, feature extraction, histogram analysis

1. INTRODUCTION
In this digital world the digital image takes an important part in many applications. [18] Digital image is a separated two dimensional matrix. Grayscale image calculate the brightness of a digital image. [10] The objects are the sets of similar pixels separated from the background through segmentation. By using segmentation, enhancement, consistency and coherent an object of the image can be identified. [5] The surface, illumination of the coin and the background of the image plays a major role to identify the coin. [9] The coin can be identifying at first by segmenting the image and then by fusing the local features and the border of the image. [19] The color, brightness, grayscale range, curves, circle of the coin can be detected by using Hough Transform and the coin can be identified. [1] The color, border, shadow of the coin to identify the coin to identify the coins by segmenting, enhancing and calculating the form factor of the binary segmentation mask. The form factor depends on the area and the perimeter of the binary mask. The image segmentation can be done by dividing the image in many regions or categories where the pixels of the same region or categories have same gray scale and neighbors from different regions have different values. [2] From gray level, color, shape, model, texture of an image, the image can be segmented regionally. [4] From the edge, the edge linking pixels the edge based segmentation is done. [6] The images of the coins are processed by an Artificial Neural Network based coin recognition system which is developed in MATLAB. The image can be trained, tested and validated by the ANN based system. [7] The gradient and the contour of the image also can be the other parameters of ancient coin segmentation. [8] By equating from coin space to Eigen face space the coin identification and classification can be done. Here Principal Component Analysis (PCA) based algorithm can be used for detection. Here we use the standard deviation of the histogram of the border image of the coins. [20] The coins have been classified by using the diameter, the shape, the gray value, the thickness, the straight lines, curves and the edge of coins as the parameters. The classification has been done by using Multilevel counter propagation neural network. [11] The clustering can be done by calculating the standard deviation of an image. Pattern recognition and classification of the objects, drawn on an image can be also done by measuring the standard deviation of any parameter of the image. Many types of projections like, vertical projection, horizontal projection are used to identify an image. [12] An image can be oriented. From projection of an image the orientation and moments also can be computed. [13] A pattern can be recognized by using the vertical and horizontal projection of an image. Here the gray value is used to calculate the values. [18] The relative frequency of each pixel which is in the gray scale image plots in the histogram. [15] Image enhancement can be done by using the histogram processing. Histogram is the graphical presentation of the gray pixel value. Image entropy of an image is the uncertainty in the image values. It can be measured by the histogram processing. Here we use artificial neural network to train the data. Artificial neural network is a processing tool which is design by using the concept of human brain and its component. [17] ANN has the intelligence to process the data and classify, recognize them. [14] An image can be classified by using ANN and detection of many features can also be done. [16] Pattern recognition technique also can be processed by ANN. There are many types of ANN. Feed forward back propagation neural network is the one of the most important type of ANN.

The proposed approach of this paper includes filtering of ancient coin images, extracting feature and classifying and recognize them using feed forward back propagation artificial neural network. Feature extraction involves histogram analysis for standard deviation value.

2. IMPLEMENTATION

2.1. Flow diagram of the method:
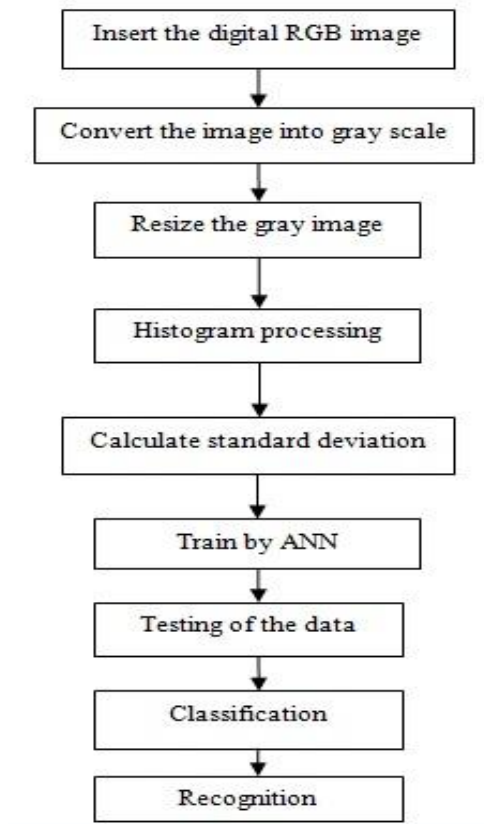
2.2. Face Image Acquisition

Digital RGB image is taken as the input. The test image has been shown in Fig-1

Fig-1

2.3. Conversion to Grayscale

The RGB image has been converted into grayscale image. The gray image is shown in Fig-2

Fig.2

2.4. Resize the gray image

The gray image has been resized to 255x255. The resized image is shown in Fig-3.

Fig-3

2.5. Histogram processing

Histogram process has been applied on the resized gray image. The image of the histogram of this image is shown in Fig-4.
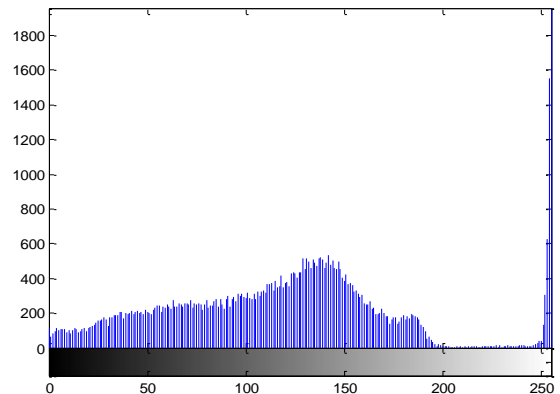

Fig.4

2.6. Calculate standard deviation

From the histogram the standard deviations have been measured.

2.7. Classification using feed forward back propagation Neural Network

An artificial neural network has n inputs and m out outputs, where $1<=m<=n$. The number of output nodes is equals to the number of the class of the input data. There is an intermediate layer between the input and output layers, named hidden layer. The input data is transferred from one layer to another by the neurons.

The classification system of Neural Network consisted of three stages. Training of Artificial Neural Network, Testing of Artificial Neural Network, Performance Evolution of Artificial Neural Network

2.7.1.Training of Neural Network:

20 images of old coins have been taken and two classes of the object drown on the images of the coins have been selected for training of the neural network. The parameters are the standard deviations of the histogram. The size of the training input matrix was 20x26.

2.7.2.Testing of Neural Network

After training, some coin images have been taken which has been furnished in Fig-12 for testing the Feed Forward Back

Propagation Neural Network. The result of the testing of neural Network has been furnished in Table-1.

Img-1.

Img-2

Img-3

Img-4

Img-5

Img-6

Img-7

Img-8

Img-9

Img-10

Img-11

Img-12

Img-13

Img-14

Img-15

Img-16

Img-17

Img-18

Img-19

Img-20

2.7.3. Result of Testing:

Table 1

Image	**Class**	**Result**
1	1	Right
2	2	Wrong
3	2	Wrong
4	1	Right
5	2	Wrong
6	1	Right
7	1	Right
8	1	Right
9	1	Right
10	1	Right
11	2	Right
12	2	Right
13	2	Right
14	2	Right
15	1	Wrong
16	1	Wrong
17	2	Right
18	2	Right
19	2	Right
20	2	Right

2.7.4. Performance Evolution of NN:

The performance of the neural network has been furnished in Table-2.

Table 2

Tested Images	Correct recognition	Wrong recognition	Performance (%)
20	15	5	75

3. CONCLUSION

In this paper the study on ancient coin classification has been shown. The coins are classified into two classes according to the objects of the coins. The classification has been done by feed forward back propagation neural network using the standard deviation values from histogram approach. The testing process has been done on 20 images and the performance of the network was around 75%. These results show that the classification was really effective and recognition chances are much higher. A further work can be carried out by using fuzzy logic to generate more situation specific classification and recognition in parallel or in combination with artificial neural network

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