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RESEARCH ARTICLE

A Direction Invariant Approach to Improve Indian Coin Recognition

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Abstract— There are number of application that requires the identification of coins. To identify the coin value, there is the requirement of some recognition system to identify the coin images accurately. One of the problems associated with this recognition is the positing of coin. In this work, a direction invariant approach is defined to identify the coin placed at different angle. To perform the directional analysis, in this work PHT approach is defined. The PHT is here defined under cosine and sine angle based transformation. The obtained results show the effective recognition of coin image.

Keywords- PHT, Directional Invarient, Cosine Tranformation, Sine Transformation

I. INTRODUCTION

Image processing is about to perform different operations on extracted digital image by using different enhancement methods. These processes accept the image as input to the system and perform different processes over it. These processes then sample and quantize the image for extraction of information. The information process is defined as the sample and quantization process called digitalization. This quantization process includes the pixel selection for processing. The work can be checked for different size so that the quantization values will convert the data to discrete data so that the enhancement to image pixels

will be obtained. The enhancement can be here obtained in terms of brightness and contrast values so that the effective pixel modification will be obtained.

Image processing is defined to improve the signal processing in the form of images so that the image characteristics will be captured and the parametric adjustment to image will be done. The work includes the parameter based adjustment over the images under different input and output images[1]. Image processing itself is divided in number of sub processes shown here under

To perform the accurate image processing system, it is required to identify the object accurately. One of the such object identification based application area is coin identification. The coins are taken as input to many business application such as weight machine, telephone system etc. These systems accept the coins and perform the identification of coin value. These kind of system requires to identify the coin accurately. Reliable and accurate identification of coin is extremely important in a number of business transactions as well as privileged information. In this section, the basic stages of recognition are explained. One of the primary Stage of the recognition process is to perform the feature extraction over the image. The feature extraction is about to perform the detection of object over the image. The object detection process is defined as the segmentation approach.

Image segmentation is one rich image processing application as well as the methodology to work as the baseline in the area of images. Image segmentation basically includes the detection of the object or the extraction of the features from the image. To detect the object or the image features, the image is divided to the several sub areas and by performing the statistical or the pixel based analysis under the different criterias, the detection of the object will be performed. There are number of approaches that are directly or indirectly associated with image segmentation. One of such approach is the Clustering.

Clustering is basically to divide the image in smaller regions under some pixel based classification. The clustering is the structural process that divides the pixel in different homogeneous groups so that similar data or the pixel area will be maintained in one group. Based on this feature based analysis the classes over the image will be defined along with the cluster boundaries. These all classes basically form the partitions over the image. These partitions divide the images in certain groups and define the data distribution over the image.

Image segmentation is the foremost step of image analysis and the pattern recognition. It is one of the critical image processing tasks to define the image separation respective to the application. In most general view the image segmentation separates the foreground from the background. There are number of image segmentation approaches and some of them are listed as under.

1.1 Histogram thresholding:

According to this approach the image is represented by the image histogram and by performing a peak and average weight analysis some pixel range is kept in the image and some is discarding. This range specification actually defines the threshold value.

1.2 Edge-based approaches:

The kind of image segmentation is the edge detection. There are number of such edge detection operators such as Sobel, Laplacian for example. Resulting regions may not be connected; hence edges need to be joined.

1.3 Region-based approaches:

This kind of analysis includes the similarity based check over the image regions to identify the relative areas or the similar areas over the image. Such kind of approach further include some methodology like region growing approach, threshold based analysis etc. The watershed algorithm also defined under the same approach

In this paper, an effective recognition of coin image is defined using PHT approach. In this section, an introduction to image processing, segmentation and recognition process is defined. In section II, the work defined by earlier researchers is discussed. In section III, the proposed recognition model is explored. In section IV, the conclusion obtained from work is defined.

II. EXISTING WORK

In this work, the existing work defined by the earlier researchers is presented. Tanzila Saba[1] has defined an intelligent approach to remove the noise over the image. Author presented a recursive mechanism to denoise the image using neural network approach. Author provided the high ratio analysis over the image for the identification of noise and to repair the image. The problem is here identified as the regression problem that is been solved using CNN approach. Lei Zhang [2] has presented a two stage model using PCA approach to identify the noise over the image and performed a group based analysis to improve the image features. The author has presented a PCA based approach for noise reduction. The recognition procedure defined by the author has improved the performance of image under noise level analysis. The noise can be removed to improve the image performance and to obtain the accurate image features over the image. Mukesh C. Motwani[3] has defined the recognition technique so that the image filtration over the image so that the image noise reduction over the image. The image classification over the image can be performed under different group based approaches so that the image improvement over the image will be obtained. The potential image analysis over the image will be obtained so that the recognition over the image will be obtained. Jiang Tao[4] has defined a research work on the denosing method using curvelet transformation approach. Author defined an improved method to define the curvelet based analysis over the image so that the image ringing and radial strip based analysis will be obtained. Author defined the region based image analysis so that the image improvement can be performed. Author defined the noise elimination over the image so that the visual features over the image will be improved.

D. Darian Muresan[5] has defined and adaptive PCA approach for image recognition. Author presented a novel approach using adaptive PCA approach under different assumption so that the corrupted image under Gaussian noise over the image will be improved. Author defined the noise filtration so that image visual fidelity so that the visual features will be improves. Author defined the analysis over the image under different recognition algorithms. Kostadin Dabov [6] has presented a image recognition approach using shape adaptive PCA approach. Author presented the recognition method under nonlocal image modeling and PCA approach. Author defined the patch based similarity measure approach to divide the image in 3D groups so that the effective image denosing will be performed. Author performed the data adaptive analysis over the image along with neighborhood pixel analysis so that the image recognition will be obtained. Francisco Estrada[7] has defined an adaptive approach to improve the image under noise vector. Author defined the probabilistic algorithmic approach for noise reduction. Author defined the random walk based approach under neighborhood analysis so that the pixel level estimation will be obtained so that the stable estimate over the image will be effective over the images and to provide enhancement over the image. Antoni Buades[8] has defined non localization algorithm for image denosing. Author defined a measure over the noise to perform the evaluation and performance improvement so that the effective image filteration will be obtained. Author performed the local smoothing filter based analysis over the image and provide the noise reduction over the image. Author defined an algorithm for local means so that local averaging for all pixels over the image. Author defined the experimental analysis over the image.

Valero Laparra[9] defined a recognition approach for kernel level image relation analysis. Author defined an alternative approach for non explicit relation formation under wavelet coefficient for image recognition. Author defined the support vector regression in the wavelet domain the enforce the relation under the signal estimation. Author defined the relational analysis over the coefficient so that the signal generation over the signal will be obtained. The SVR based approach is defined for noise reduction. Sebastian Bauer[10] defined an effective recognition approach for image registration under CT surface for radiation analysis under the shape mismatch approach. Author defined the testing mechanism under the synthetic and real data evaluation over the experiments. Amir Beck[11] defined a gradient analysis under the algorithmic approach so that the constraint analysis under total variation over the image is performed. Author defined the recognition approach to identify the relative problems. Author defined the gradient based scheme for image recognition and deblurring problem under discretized the total variation over the minimization for model constraints. Author defined the TV based image deblurring. Author defined the acceleration over the dual image to the recognition problem so that the novel monotone version of a fast iterative shrinkage algorithm.

III. PROPOSED WORK

Coin recognition is one of the business application based recognition system used to recognize the coin object over the imageset. The work is divided in two main stages. In first stage, the extraction of coin object from the image is required. Once the Coin ROI is identified, the distance based analysis between the input coin object and database objects is performed to recognize the coin image. The presented work is the implement over the existing approach by providing the directional invariance. It means, the coin placed at different angle can also be recognized by the proposed application. To obtain the rotational invariance, in this work a Polar harmonic transformation approach is defined. This approach is further divided in

two sub categories based on the rotation function. The approach includes the PST (Polar Sine Transformation) and PCT (Polar Cosine Transformation).

Polar harmonic transforms (PHTs) are orthogonal rotation invariant transforms that provide many numerically stable features. The kernel functions of PHTs consist of sinusoidal functions that are inherently computation intensive[1][2]. We develop a fast approach for their computation using recursion and 8-way symmetry/anti symmetry property of the kernel functions. The clustering of pixels at eight radically symmetrical locations enhances the speed of computation[3]. Experimental results show that the proposed method is faster by a factor lying between three and four compared to the existing fast method.

A) Pulse Harmonic Transformation

Presents a new method to match a 2D image to a translated, rotated and scaled reference image. Polar Harmonic Transforms (PHTs), which can be used to generate rotation-invariant features. The computation of the PHT kernels is significantly simpler compared with that of ZMs and PZMs, and can hence be performed at a much higher speed. With PHTs, there is also no numerical instability issue, as with ZMs and PZMs, which often limits their practical usefulness. A large part of the computation of the PHT kernels can be precomputed and stored. In the end, for each pixel, as little as three multiplications, one addition operation, and one cosine and/or sine evaluation are needed to obtain the final kernel value. In this, three different transforms will be introduced, namely, Polar Complex Exponential Transform (PCET), Polar Cosine Transform (PCT), and Polar Sine Transform (PST).

The presented work is in same direction so that the angle independent recognition of the coin image will be obtained. In this work the match is been performed based on the 2D rotation of the coin image under the concept of Polar Harmonic Transformations (PHTs). This method basically performs the rotation without affecting the coin features. The PHT kernel is significantly defined to obtain the matching stability and to improve the matching performance. This PHT kernel is defined with some pre-computed equations in form of multiplicative and additive operations. Based on these operations, the transformation over the system will be obtained. These transformations includes the Polar Complex Exponential Transformation (PCET), Polar Cosine Transform(PCT) and Polar Sine Transform(PST). In this work, we have used these rotational aspects to identify the fingerprint. The algorithmic aspect of the presented work is given as under

Table 1: Algorithm

Algorithm
{
1. Generate the dataset of coin images
2. Maintain the Database of Input Fingerprint Images. The Database if collected from external sources
3. Perform the training on input images and extract the features from the image set. These features includes the Euclidian distance analysis
4. Perform the image analysis and perform the image preprocessing to convert the image and imageset to normalized format
5. Implement the rotational image of input finger print under PCT and PST
6. Generate the rotational input image with all database images
7. Extract the image feature in the form of Euclidian distance analysis
8. Compare the Eculidan distance with all database images and identify the most matched image.
9. Present the most matched image as the output image.
10. Analysis of Results in terms of false positive and false negative analysis

}

IV. RESULTS

The presented work is implemented in Matlab environment. The dataset is taken with 10 different coin images of similar size. The basic features of the taken dataset is listed as under in table 1

Table 1 : Dataset Features

Dataset	Properties
Number of Images	10
Color	No
Lighting	Mix
Resolution	Mix
Individuals	10

Figure 1 is showing the dataset being used in this work

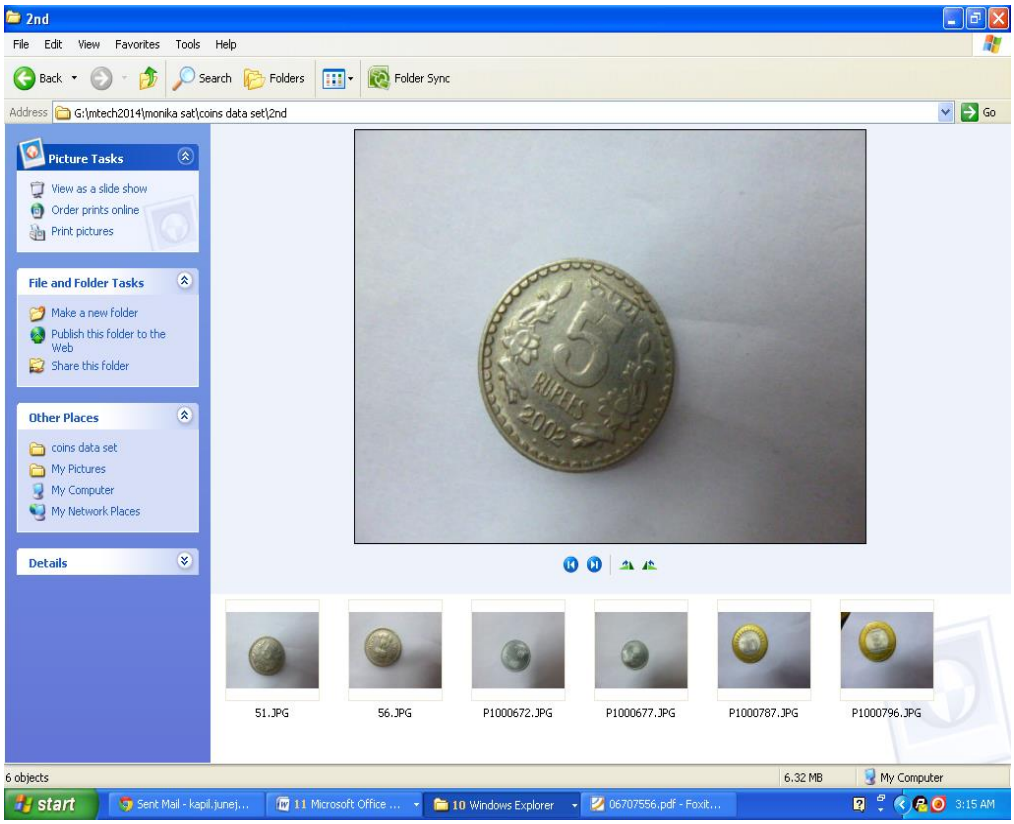

Figure 1 : Coin Dataset

In this work, the input image is selected and the rotation of the image is been performed at different angle. At each angle, the comparison with all database images is been performed.

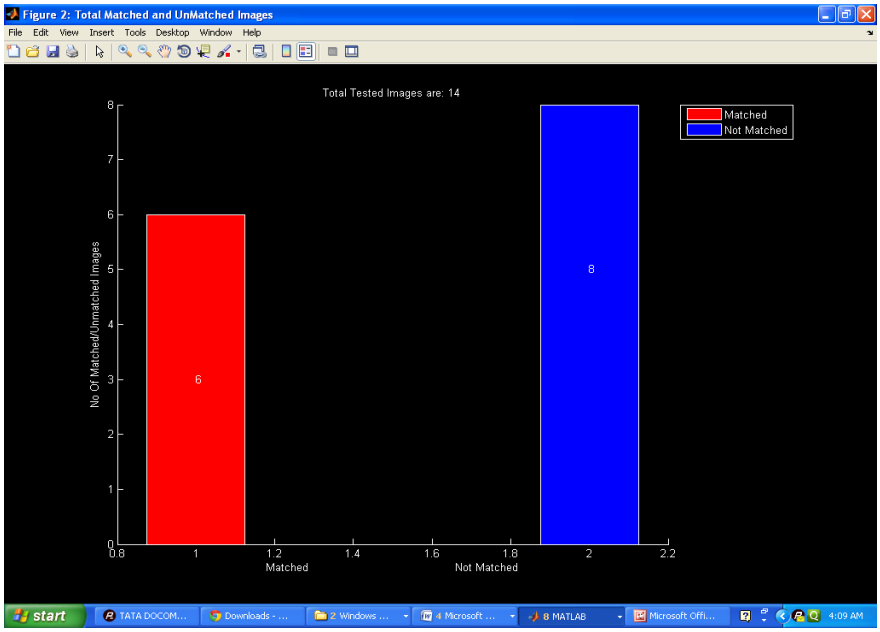

Figure 2 : Matching Result

The main work of presented approach is to perform the recognition of image under the rotational extracted features. The input image is compared with all 14 images presented in the dataset. As we can see, as the input image is rotated at 30 degree under PST approach. The rotational match successfully done with 6 images and the non matched cases are 8. The figure is showing the matching results obtained under the PST approach.

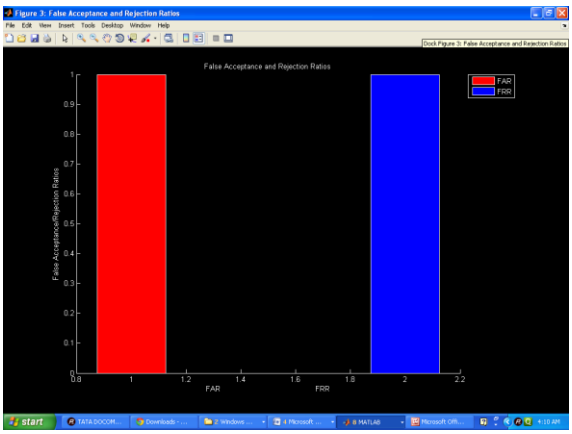

Figure 3 : Acceptance and Rejection Analysis

Here figure, 3 is showing the marching results in terms of acceptance and rejection of input image. The figure is showing the analysis in terms of false positive and false negative results. The results shows that the FAR and FRR ratio is equal with value 1.

V. CONCLUSION

In this paper, a direction invariant coin recognition approach is presented. The presented work uses the PHT based approach to perform the recognition at different angular aspects. The analysis of the work is done in the form of effective recognition rate obtained from the work.

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