International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

AUTOMATED INDIAN COIN RECOGNITION WITH ROTATION INVARIANCE USING IMAGE SUBTRACTION TECHNIQUE

Phakade S.V.[1], Shirsath D.O.[2] PATIL A.G.[3],

[1,2,3]*Department of E&Tc, P.V.P.I.T. Budhgaon (India)*

ABSTRACT

This paper discuss implementation of various Indian coin recognition of different denomination. Coins have been the integral part of our day to day life. These techniques facilitate transaction making it easier in all forms of trade. Keeping all the essential factors in mind a system has been created which recognizes coin based on image subtraction technique. The spiraling business transaction at vending machines and automated systems working on token have spurred better coin recognition techniques saddled with increased robustness The process performs 3 checks (radius, coarse and threshold) on the input image. The stated subsequent checks enable the technique to endorse Rotation Invariance, thus obviating the need of placing the coin at a certain angle. Also, the technique does away with the requirement of placing the front face of the coin up. Subtraction between the input object image and database image is performed. Further, plotting the resultant values gives minima which if less than a standard threshold establishes the recognition of the coin. Results of MATLAB based simulations have been reported

Keywords - Quality control, Image acquisition, image enhancement, noise reduction, edge detection,

I. INTRODUCTION

Humans easily recognize familiar patterns or objects regardless of their size or orientation differences. This is due to our intelligent system of perception which has been trained to recognize the objects over time. However, we are able to simulate our perception of objects and pattern recognition in intelligent machines using trained neural networks [1].

The paper proposes a coin recognition method using image subtraction technique which has an advantage over the conventional identification methods used commonly in slot machines. Most of the coin testers in slot machines, work by testing physical properties of coins such as size, weight and materials. However, if physical similarities exist between coins of different currencies, then the traditional coin testers would fail to distinguish the different coins.

The image subtraction technique takes two images as input and gives a third image as output, whose pixel

International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

values are simply the pixel values of the first image minus the corresponding pixel values of the second image. Modus operandi consists of the stated technique. It also incorporates the radius check which would assist in choosing the befitting coin from the database.

Database amasses the standard coin used for recognizing the input image. Images formulating the database are taken under standard conditions including the distance, background and lighting. Once the precise image is selected, its feature are extracted (explained in II) and subtracted from the input coin image (referred to as object image). Image rotation invariance is introduced by rotating the image at fixed angular interval thus providing us with the exact angle of difference between the coins on analyzing the plot of the subtracted values [1, 3].

Extracting the minima of the plot and on comparing it with a standard threshold value, the object coin can be determined as coin of same denomination or not. Thus, coin stands recognized.

Fig. 1 Front side of various Indian coins

Fig. 2 Back side of various Indian coins

Shatrughan Modi [3] had proposed a neural pattern recognition system, which is insensitive to rotation of input pattern by various degrees. Results show that the neural network approach works well for variable rotation pattern recognition problem. In this the centre of the coin is located and concentric rings are used to achieve rotation-invariance.

A rotation-invariant pattern recognition system has been constructed using neural networks to recognize the patterns [1,3]. The mathematical calculations are performed and the output signals are generated and kept ready for training. Thus by identifying the center point alone in a coin may not be sufficient to localize the numeral in the coin because in some coins, the numeral is seen only at the bottom of the coin where the center point identified by the automatic coin-classifying machine may fail to detect the numeral in the coin thus giving a new idea for further studies.

This paper presents an image subtraction recognition system which is insensitive to rotation by any number of degrees. As such a system is useful in problem related to coin recognition

II. ASSUMPTIONS

Following parameters are kept constant during image acquisition:

- Lighting condition
- Distance and Position
- Perpendicular image acquisition take care that the surface of the coin is clean

International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

III. ROTATION-INVARIENT IMAGE SUBTRACTION TECHNIQUE

The proposed approach of coin recognition consists of five modules namely, image acquisition, image segmentation, radius calculation, image subtraction and Threshold comparison. Input image of size (320*320 pixels) is acquired and coin is segmented through it. Fig. 3 elucidates the block diagram of the proposed methodology.

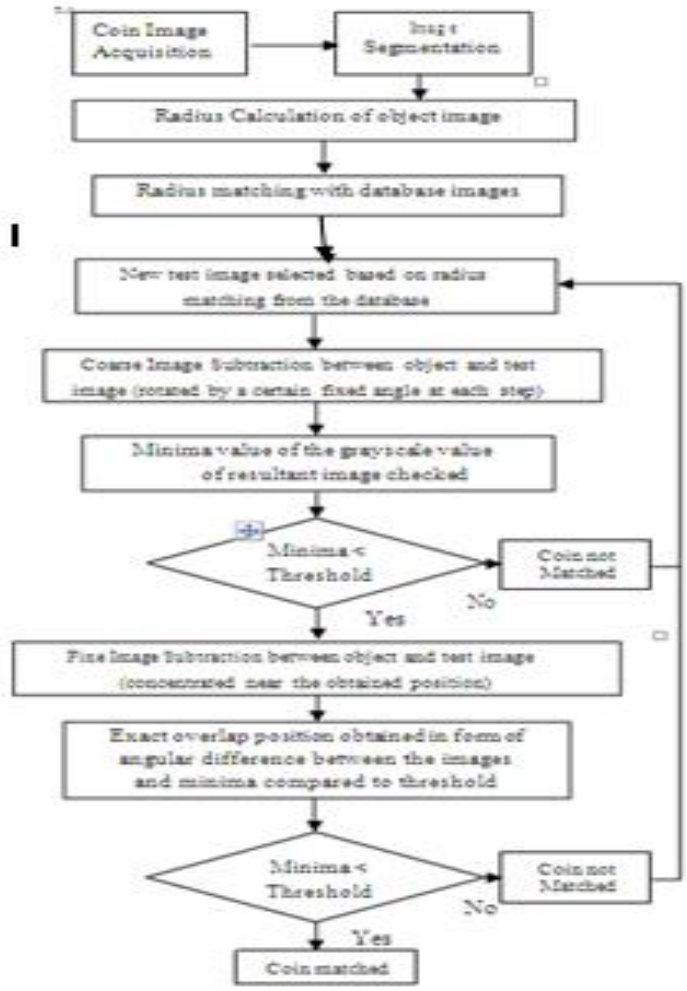

Fig. 3 Flow chart of the methodology

A. IMAGE ACQUISITION AND SEGMENTATION

This section describes the image acquired and the segmentation process required for coin recognition. A good resolution webcam is used for image acquisition. The next step of the coin recognition system would be image segmentation, i.e. separating the coin image from the background. Fig. 4 illustrates the process of image segmentation wherein the image is firstly converted into grayscale image in accordance with the formula described in Eqn. 1

$$gray = (0.299*r + 0.587*g + 0.114*b) \quad (1)$$

The image is further adjusted by increasing the contrast and then converting it into a binary image by setting the pixel whose value is greater than a certain threshold value to 1 else 0. The fourth image in Fig 4 describes how a

binary image looks like. Traversing row wise we get two positions which depicts the two ends of diameter. We get the centre in terms of horizontal axes. Following the same methodology column wise, we get the centre in terms of vertical axes. Thus, we get the exact position of the coin into which the parent image is readjusted shown in fifth image of fig. 4.

Fig. 4: Image Segmentation

Edge Detection- Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction. So that we use edge detection for coin detection. From table.1 we conclude that canny filter is useful for edge purpose.

Edge detection methods

Type of Filter	Sobel	Canny	Prewitt
Edge Detection	94%	97%	92%

TABLE I

B. Radius Calculation

Diameter is calculated by finding the difference between maximum and minimum position of white pixels of the binary image formed during image segmentation shown in Fig. 4. Being aware of the fact that Indian coins have distinct radius, this cardinal step provides the value based on which the suitable image from the database gets selected for further process, abridging the process time and irrelevant data

C. Image Subtraction with Rotation Invariance

Having procured both the object and test image, two subsequent checks are performed narrowing down the recognition process.

Coarse Subtraction*:* The test image is given one full rotation in steps of fixed angular distance of say 30º. At each instance of rotation image subtraction is carried between the rotated test image and the input object image. The two images basically are a 2-d array consisting of gray values. Subtracting these array yields gray values begetting a third image.

Subtracted (r,c) = object (r,c) – test (r,c) (2)

International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

Fig. 5Fig. 6 Image subtraction at 30º difference

Fig. 5, 6 illustrates the subtraction at various angles.

These figures elicit that resultant image exhibits darker regions that persistently increases until the rotation crosses the angle of object image. If we plot a sum of gray values of the resultant image we get a minima at some angle near which the test and object image tend to overlap. Sum of grayscale values for the subtracted image at different angles are shown in Table I.

GRAYSCALE SUMMATION AT VARIOUS ANGULAR DIFFERENCES BETWEEN OBJECT AND TEST IMAGE

Rotation of coin (in degrees) (For Rs. 5 coin)	**Grayscale values sum of subtracted image (x 10^5)**
0	0
30	1.22
60	1.49
90	1.69
120	1.65
150	1.51
180	1.48
210	1.542
240	1.64
270	1.698
300	1.52
330	1.19
360	0.1169

TABLE II

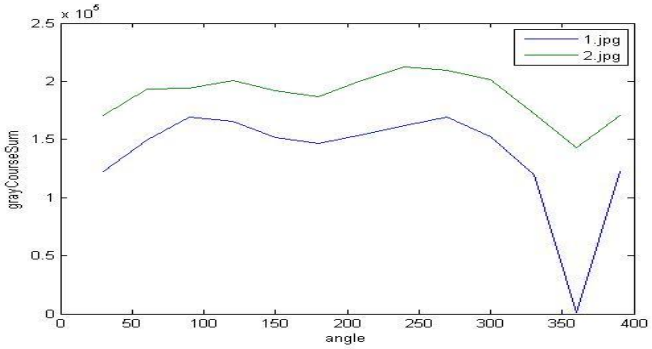

Fig. 7 Plot of Grayscale value sum v/s angle of rotation

Observing the plot in Fig. 7, we note a minima occurring at a certain angle. This angle corresponds to the position of overlap of object and test image. Albeit, the approximate angle of overlap is known the fact that coin matches is still vague thus evoking the need of fine subtraction. However if the minima values is greater than a

International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

certain threshold (1.5 x 10^5 in this case) it can be said directly that the coin does not matches.

D. Threshold Comparison

Once we get the minima of the gray value sum, based on comparison with a standard threshold, deductions are made whether the coin matches or not. If the minimum value lies below the threshold, coin identification is established.

Thresholding (No of reading)	Coin Type		
	1	2	5
1	236	256	52
2	239	247	58
3	236	260	56
4	240	251	53
5	243	261	54
6	238	254	59
7	241	249	57
8	240	256	56
9	241	256	58
10	245	248	55

TableIII. Pixel values of coin

Using above reading we set maximum & minimum value pixel for threshold to detect coin

G(x,y)= 1 if 236 <=g(x,y)<= 245
G(x,y)= 2 if 247 <=g(x,y)<= 262
G(x,y)= 5 if 50 <=g(x,y)<= 60

IV. EXPERIMENTAL RESULT

Fig 8.orignal image of Rs.5

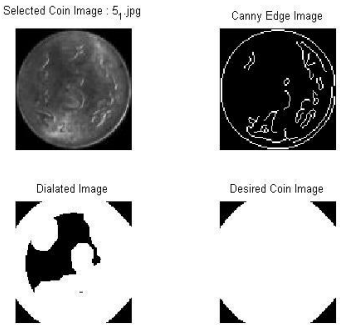

Fig 9. pre- processed image of Rs.5

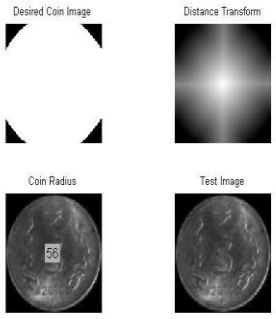

Fig10 .Feature extraction

Fig11. Result of Rs.5

International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

Fig12. Rotated image of Rs.5

V. CONCLUSION

In this paper ,we have studied different kinds of edge detection. The canny Edge detection method gives 97%. In the edge detection we got the correct edge using canny filter. For Rs.1 coin, we are tested 10 times of setting of threshold. At the end we get thrsholding range of Rs.1 from 236 to 245 pixel.For Rs.2 coin ,we are tested 10 times of setting of threshold. At the end we get thrsholding range of Rs.2 from 247 to262 pixel.For Rs.5 coin, we are tested 10 times of setting of threshold. At the end we get thrsholding range of Rs.5 from 50 to 60 pixel.For the coin other than the specified dataset , tests showed the results as "Not a Indian coin".Here we used the image substraction using rotation invariance method. In image substraction we used coarse substraction. By this method we get correrct result nearlyl to 99.9% of the time.Also we tested the non Indian coin using our method. This method working correctly.

REFERENCES

[1] Vaibhav Gupta, RachitPuri, MonirVerma "Prompt Indian Coin Recognition with Rotation Invariance using Image Subtraction Technique" Electronics and Communication Engineering Department Thapar University, Patiala -147001, India

[2] C.M.VELU1 and P.VIVEKANANDAN2 ".Indian Coin Recognition using Heursticapproach and Hough Transform" HOD of CSE, SKR Engineering College, Chennai – 602 103, India.Director, Knowledge Data Centre, Anna University, Chennai – 600 025,India

[3] ShatrughanModi Dr.SeemaBawa"Automated Coin Recognition System using ANN"Dept. of Computer Science and Engineering ThaparUniversityPatiala-147004, India.

[4] Sebastian ZAMBANINI – Martin KAMPEL "Coin Data Acquisition for Image Recognition"Vienna University of Technology, Institute of Computer Aided Automation, Pattern Recognition and Image Processing Group,Vienna, Austria Cortex", Cognitive Neuropsychology Vol. 17: 1/2/3, pp. 13–34, 2000