

A Comparative Survey on Various Coin Recognition Systems Based on Image Processing

Yamini Yadav¹, Apoorvi Sood²

¹M. Tech, Computer Science and Engineering ITM University, Gurgaon, India
yadavyamni08@gmail.com

²Assistant Professor, Computer Science and Engineering ITM University, Gurgaon, India
soodapoorvi@yahoo.com

Abstract: Coins are a fundamental need of human life. They are used in everyone's daily routine, like banks, transport, market and these spare change also has some other uses than getting traded in for cash like for measurement purpose, in games (toss), in organizations for research purpose, etc. So, it holds a great importance that coins can be detected with high accuracy. The Aim of a coin recognition system is to classify high volumes of coins with high accuracy within a short time span. In this paper we present a comparison between various coin recognition systems in terms of their accuracy. Different coin recognition approaches have been proposed by various researchers based on image recognition method. One can easily detect and recognizes coins with the help of these systems. Classification is based on images from both sides and a radius of the coin. On the basis of this literature survey we can say that image processing is the most effective method for coin recognition.

Keywords: Back Propagation Network, Coin Recognition, Histogram, Image Processing, Image Segmentation, Neural Network.

1. Introduction

There are many coin operated equipment in the world such as an automatic machine for payment especially vending machine. Coins used in many countries have various patterns such as shape, size, surface design, weight etc. Some coins used in different countries have similar in size, weight and surface design but different value. For example 12 European countries use the Euro as the official currency. All 2-Euro coins have the same design on obverse side but different design for each European country on the reverse side. So it is difficult for an automatic system to recognize coins with a similar pattern because coin identification by machines (mechanical method based, electromagnetic method based) relies currently on the assessment of the physical parameters of a coin.

Today in many parts of India, one rupee coin telephone booth is widely practiced. Any metal like that of the original coin's dimension can be inserted in the coin box and the purpose can be solved. That means if we give two coins one original and other fake having same diameter, thickness, weight and magnetism but with different materials to the mechanical method based system then it will treat both the coins as the original coin so these systems can be fooled easily. In the recent years image based coin recognition systems have also come into existence. The coin recognition systems based on images can also be divided into two categories: method based on image registration and method based on feature vectors with rotation variance. In these systems first of all the image of a coin is taken with a digital camera or scanner etc. Then these images are processed by using techniques like Gabor Wavelets, DCT, FFT, Decision Trees, Image

Subtraction etc. and extract various features from images. Now based on these features different coins are recognized with a high accuracy rate.

This paper presents various existing techniques and systems proposed by various researchers on image based coin recognition. This paper is managed as follows: In section 2, we discuss some basic terms related to coin recognition systems. Section 3 presents a discussion on various techniques and systems for coin recognition. Finally, future scope and conclusion is discussed in section 4.

2. Some Basic Terms

2.1 Artificial Neural Network

An artificial neural network is capable of pattern recognition and machine learning. It resembles in characteristics with a biological neural network, like a human brain. It learns by example.

2.2 Recognition

The recognition process is divided further as

2.2.1 *Coin Detection:* Detect the coin from given image, separate it from the background.

2.2.2 *Coin Verification:* Based on stored patterns, it verifies the coin as correct verification or false verification.

2.3 Segmentation

Image segmentation is a process of portioning the digital image into multiple regions that can be associated with the properties of one or more criterion. Properties like gray scale, color, texture and shape help to identify regions and similarity of such properties, is used to build group of regions having a particular meaning.

2.4 Histogram

The histogram of an image tells about the distribution of Gray levels in image massively useful in image processing; especially in image segmentation.

2.5 Thresholding

Thresholding methods define a range of brightness values (the thresholds) in the original image and select the pixels within this range as belonging to the foreground, whereas the remaining pixels are rejected to the background.

3. Various Systems/Techniques for Coin Recognition

R. Bremananth et al. in 2005 [1] proposed a system that focuses only on the numerals rather than the use of other images presented on the front and rear side of the coin. For experiment they used 1-rupee, 2-rupee, 5-rupee Indian coin. Extract numeral image from the given coin image and this image is used for character recognition procedure. This proposed approach can easily be implemented in any real time business transactions. The system resulting from this research recognizes numerals using neural pattern analysis with a 92.43% success rate of our test data. The various steps followed by this system is shown in Figure 1.

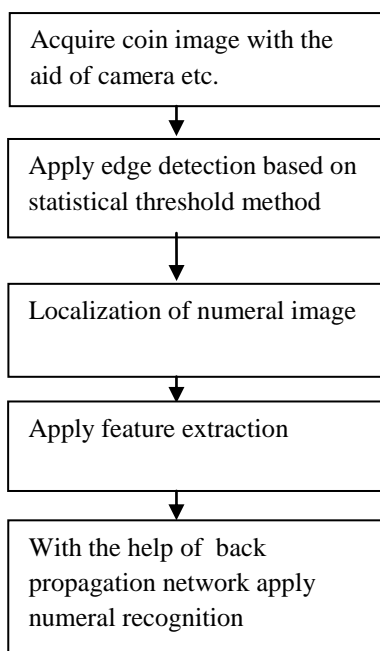


Figure 1: Proposed Methodology

Adnan Khashman et al. in 2006 [2] proposed an intelligent coin identification system (ICIS) that uses coin patterns for identification helps preventing confusion between different coins of similar physical dimensions. For recognition of rotated coins of various degrees, ICIS used pattern averaging and neural network. In pre-processing phase ICIS apply thresholding, cropping, compressing, trimming, pattern averaging on images. And then neural network is trained using these images. ICIS used 1 TL and 2 EURO coins in recognition. ICIS used a 3layer back propagation neural network with 400 input neurons, 25 hidden neurons and 2 output neuron. The neural network is trained using 20 images out of available 120 coin images. The Accuracy rate achieved was 96.3%. Figure 2 shows various steps used in this system.

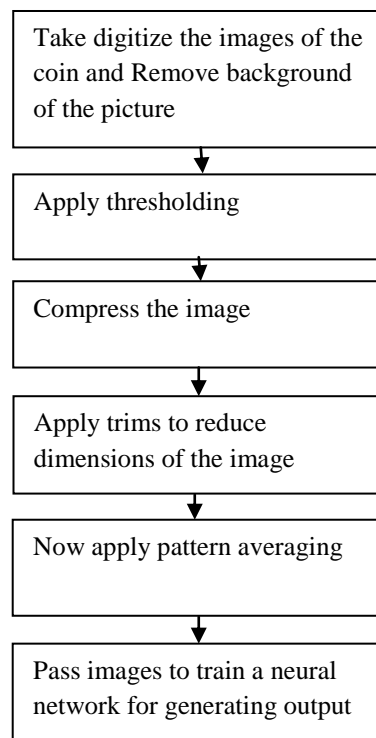


Figure 2: Proposed Methodology

Hussein R. Al-Zoubi et al. in 2010 [3] suggested a coin recognition method using a statistical approach to classify Jordanian coins. There are seven different coins used in Jordan: 500fils, 250fils, 100fils, 50fils, 25fils, 10fils, and 5fils. Color and area of a coin was the key feature for classification. First convert the colored image into gray level and then apply the threshold value to convert it into black and white image. Then the binary image is cleaned by opening and closing through erosion and dilation, after that calculate the value of each RGB color. Then on the basis of these value decisions is made that to which category the coin belongs. Total 1050 experiments, 150 for each coin were carried out to examine the proposed

system. The Accuracy rate achieved was 97%. Proposed methodology of this system is given in Figure 3.

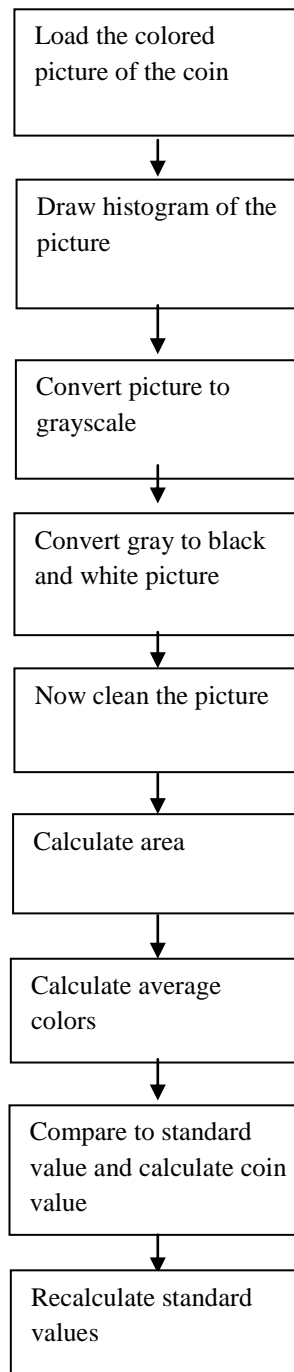
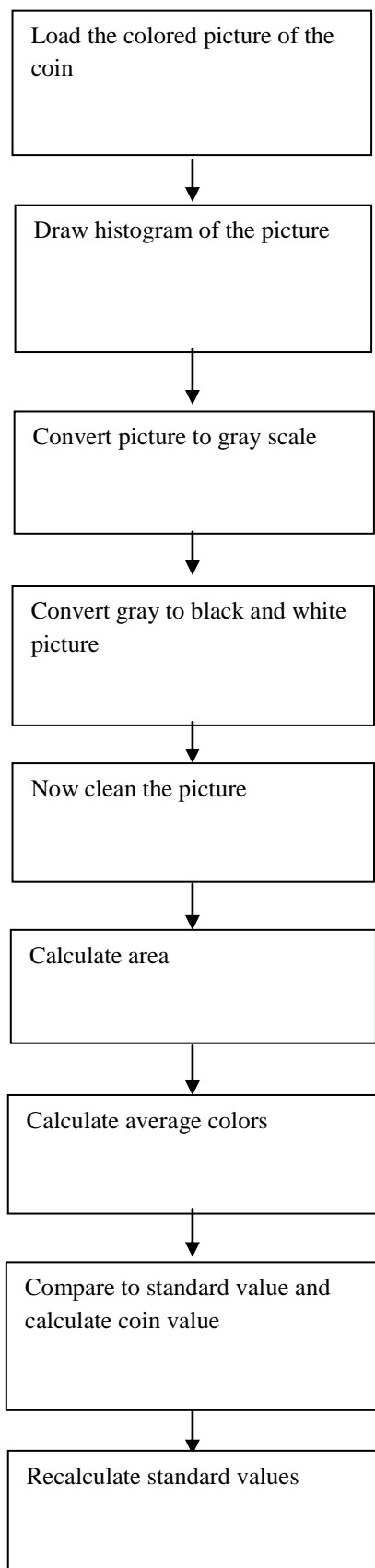


Figure 3: Proposed Methodology

Vaibhav Gupta et al. in 2011 [4] presented a method based on image subtraction for recognition of Indian coins of different denomination. The Process performs 3 checks (radius, coarse and fine) on the input image. Instantly compute the radius of the input image and then based on the radius a test image is selected from the database. Then subtraction between the input image and database image is performed. By plotting the resultant values we get a minimum value which if less than a standard threshold provides the identification of the coin. Figure 4 is showing various steps for this coin identification system.

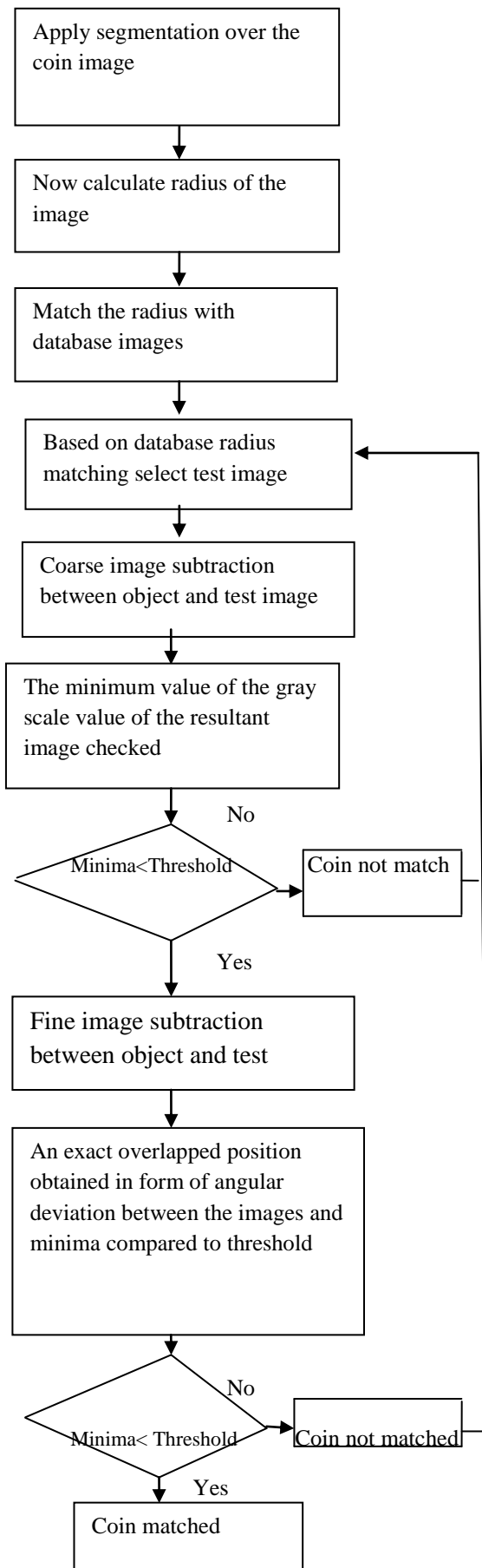


Figure 4: Proposed Methodology

Neural Network based Automated Coin Recognition System for Indian coins. They used Indian coins of denominations `1, `2, `5, and `10. This system takes images of coins from both sides. First of all apply pre-processing for images like cropping, trimming, pattern averaging etc. and then passed the input data set to Neural Network for training. 4536 images are used for training and 252 images are used for validation and testing each. It eased back propagation neural network with 400 input units, 30 hidden layers and 14 output units. This system gives 97.74% recognition rate. Flow chart of this system is as shown in below Figure 5.

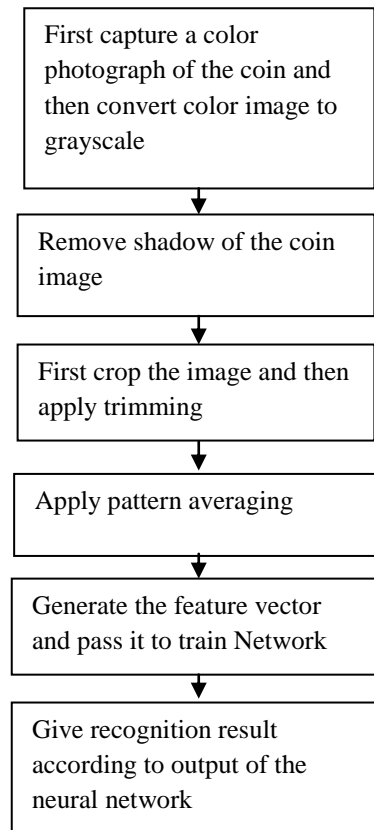


Figure 5: Proposed methodology

Saranya das.Y.M et al. in 2013 [6] presented a system to classify Indian coins discharged recently. This system is based on Advanced Harris-Hessian Algorithm, used the parameters such as size, weight, surface etc. of coins and also used the concept of rotation invariance. The primary goals of this project are: Recognize the coins, count the coins and then get the total value. First we apply preprocessing of the image and then pre-processed images are passed to the Harris-Hessian detector, it detects interest points. Now these features are fed to the Hough Transform, it detects circles and calculates the radius of coins. . It is a low cost system having recognition rate close to 100%. Proposed methodology given by Saranya Das is given in Figure 6.

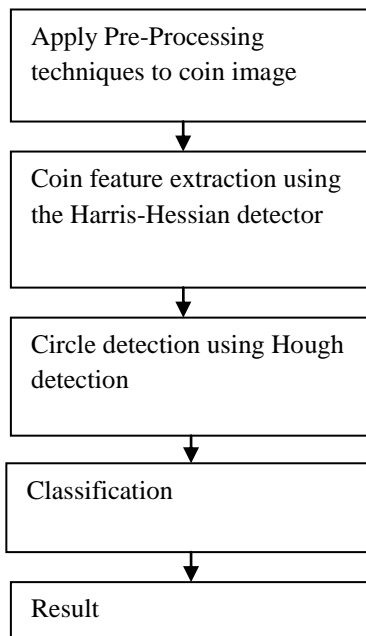


Figure 6: Proposed Methodology

Deepika Mehta et al. in 2013 [7] presented a system to detect and recognize the Overlapped coins using Otsu's Algorithm based on the Hough Transform technique.

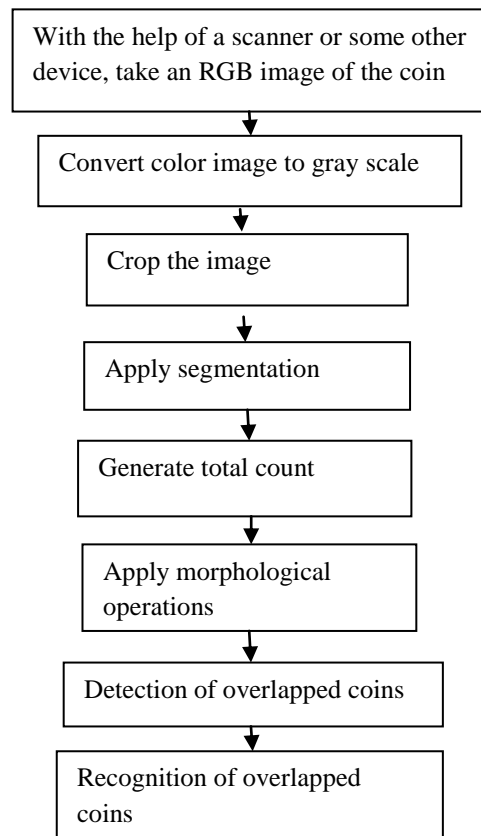


Figure 7: Proposed Methodology

This project includes three step detection, extraction and recognition. For segmentation uses an Otsu's algorithm, for detecting overlapping uses the Hough transform and for recognition uses radius thresholding. The Detection rate of overlapped coins is 91% and recognition rate is 40% to 50%. Figure 7 shows various steps followed by this system.

based on image processing. In Table 1 we compared all researchers' work which is really helpful for study at a glance. Future work can be done to achieve 100% accuracy. However there are so many methods has been proposed till now for modern coins, but still very less work has been done for the recognition of a coin whose physical state is not that much better (ancient coins).

4. Conclusion and Future Scope

This paper focused on different systems for coin recognition

Table 1: Comparison of Various Techniques Used for Coin recognition

Sr. No.	Year	Author Name	Technique Used	Coins Used	Accuracy Achieved
1	2005	R. Bremananth et al.	Gabor filter, Statistical color threshold	Rs.1, Rs.2, Rs.5 Indian coin	92.43%
2	2006	Adnan Khashman et al.	Neural Network, Pattern Averaging	2 Euro and 1 Lira coin	96.3%
3	2010	Hussein Al-Zoubi et al.	Statistical Approach	Jordanian coins	97%
4	2011	Vaibhav Gupta et al.	Image Subtraction	Indian coins	
5	2011	Shatrughan Modi et al.	Artificial Neural Network	Rs.1, Rs.2, Rs.5, Rs.10 Indian coins	97.74%
6	2013	Saranya das. Y. M et al.	Harris-Hessian Algorithm	Indian coins	App.100%
7	2013	Deepika Mehta et al.	Otsu's Algorithm, Hough Transform	Indian Coins	40 to 50%

References

- [1] R. Bremananth, B. Balaji, M. Sankari and A. Chitra, "A new approach to coin recognition using neural pattern analysis" IEEE Indicon 2005 Conference, Chennai, India, 11-13 Dec. 2005.
- [2] Khashman A., Sekeroglu B. And Dimililer K., "Intelligent Coin Identification System", Proceedings of the IEEE International Symposium on Intelligent Control (ISIC'06), Munich, Germany, 4-6 October 2006.
- [3] Al-Zoubi H.R., "Efficient coin recognition using a statistical approach", 2010 IEEE International Conference on Electro/Information Technology (EIT), 2010.
- [4] Gupta, V., Puri, R., Verma, M., "Prompt Indian Coin Recognition with Rotation Invariance using Image Subtraction Technique", International Conference on Devices and Communications (ICDeCom), 2011.
- [5] Shatrughan Modi, Dr. Seema Bawa, "Automated Coin Recognition System using ANN" International Journal of Computer Applications (0975-8887) Volume 26-No.4, July 2011, Pp. 13-18.
- [6] Saranya das. Y. M, R. Pugazhenthii, "Harris-Hessian Algorithm for Coin Apprehension", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 2, No 5, May 2013.
- [7] Deepika Mehta, Anil Sagar, "An Efficient Way to Detect and Recognize the Overlapped Coins using Otsu's Algorithm based on Hough Transform technique", International Journal of Computer Applications (0975-8887) Volume 73-No.9, July 2013.

[8] Md. Iqbal, Goutam Das, Krishna Gopal, Pratiti Das, "Classification of Ancient Coin using Artificial Neural Network" International Journal of Computer Applications (0975-8887) Volume 62-No.18, January 2013.

[9] Supreet Kaur, Richa Sharma, "A New Approach to Detect Partially Overlapped Coins" International Journal of Computer Applications (0975-8887) Volume 65-No.8, April 2013.

Author Profile



Yamini Yadav received the B. Tech degree in Computer Science from Gurgaon College of Engineering for Women in 2012 and pursuing M. Tech in Computer Science from ITM University.