

# A Survey on various Techniques of Coin Detection and Recognition

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## ABSTRACT

Coin which act as the basic need of the human being and today life of human beings depends solely on machines so the detection and recognition of coin is very important rather than counting coins manually. One can easily detect and recognize the coins by using various techniques. This paper focuses on the variety of techniques that have being used to detect and recognize the coins of different denomination. A variety of techniques and approaches have being proposed such as Circular Hough Transform, Artificial neural networks, heuristics etc which further help in recognition of coin. The performance rate of detection and recognition was upto 97.74% as computed by Neural Networks .The performance analyzed was on the basis of variety of parameters used such as size, weight, thickness and many more. Future improvement can be done detection and recognition of overlapping of coins.

## General Terms

Image Processing, Coin Detection, Coin Recognition, Algorithms.

## Keywords

Hough Transform, Coin Detection, Coin Recognition.

## 1. INTRODUCTION

Coins had their history from the ancient times and still act as the major part of human today life. Counting coins manually was just a wastage of time so for this the detection and recognition of coins was important. This paper is concerned with the reliable detection and recognition of different denomination of coin. The detection and recognition done by using variety of techniques. The techniques used Circular Hough Transform technique, registration technique, neural networks, Heuristics approach, vector quantization, histogram technique, sensors, Dagobert. All such techniques were used to detect and recognize the coins. Circular Hough technique uses the canny edge to detect edges and based on the radii of coin detection and recognition is done [1], basic limitation arises when the image is captured from distance. Marco Reisert et.al [6] presented the registration technique was completely on the basis of directions of gradient vectors. The detection and recognition were automatically sorted and classified high volume of coin in small amount of time. The limitation was not able to deal with small sizes of coin.

C.M.Velu and P.Vivekanandan [5] presented a paper which concentrated on Heuristic approach which is done on the basis of rotational invariance. The coin was well recognized on the basis of zooming. The limitation was based upon the feature like when coins are released during various time periods in detecting and recognizing the coin. Further the other technique known as Vector recognition which is based on the texture of the tail side of the coin [7]. The limitation was both sides of the coin were not recognized and other factor to detect whether it is a coin or a non coin was also not achieved. Marcel Tresanchez et.al [9] presented as a counterfeit coin detector applied to the two euro case which make use of the sensors of optical mouse. The detection was based on the short distance image acquisition capabilities. The limitation was need to rotate the coin to increase the area covered by sensor. Counting only few coins were easy or detection of coins but further Michael Nolle et.al[10] described a pattern recognition method used in the detection of coins .The technique used to sort high number of coins was Dagobert technique. Further work can be extended was to do with the improvement on the recognition results and speed. The proposed papers was cited for the detection and recognition of coins based upon the images of different types. The detection and recognition was done on the basis of the approaches and amount of the coins of different countries used , the designing of the coins and the solely depend upon the parameters used .

## 2. METHODOLOGY OF COIN RECOGNITION

Coin recognition is done by variety of methods and techniques. The steps required to detect and recognize the coin is described by using the following flow chart(Fig 1). These steps can vary according to the technique used.

1. Start the process.
2. Data capturing or data acquisition is being done.
3. After capturing of the image segmentation process is being initialized.
4. Once segmentation process is started the coin image is segmented and then the cropping of image is done.
5. Further the features of coin image are extracted such as the texture of the image.
6. Threshold value of grey scale image is calculated obtained by segmentation.

7. Then image is passed through the vector quantization through which the data is compressed.
8. After testing of an image from every possible angle it determines the edges.
9. In the end all terms merged together to arise at a resultant.
10. These all stated steps results in detection and recognition of an coin image.

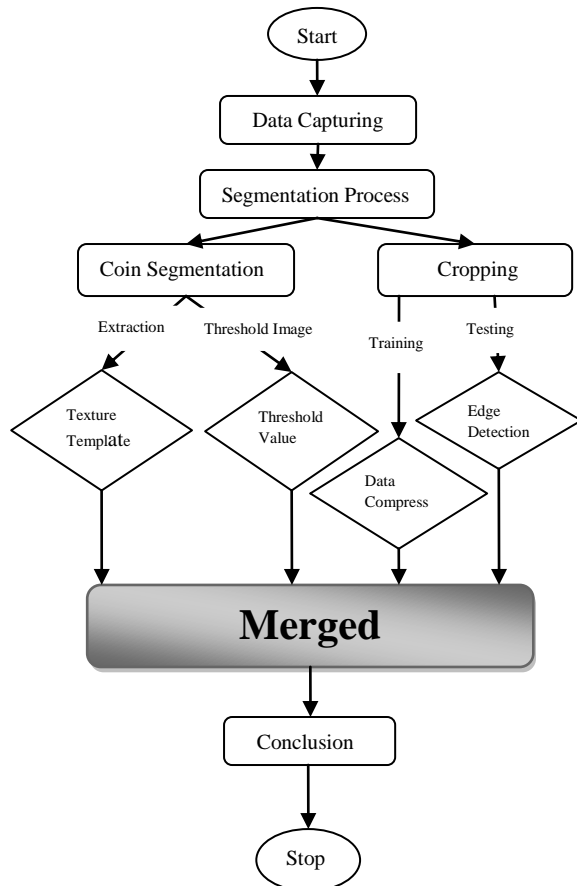


Fig 1: Flow Chart to represent the Recognition

### 3. TECHNIQUES USED FOR COIN RECOGNITION

Authors proposed a variety of techniques used for the detection and recognition of coin. In this paper the goal of the researchers is to detect and recognize the coin automatically rather than counting manually.

#### 3.1 Circular Hough Transform

The hough transform technique used for extracting the variety of features from an image like lines. Circular hough transform (CHT) is a extension of Hough Transform(HT) that is to identify the circular objects from an image. This technique helps in overcoming the limitation suffered by HT. The proposed technique uses a canny edge detector in order to generate edges and then is to detect and recognize the coin by using CHT. The different denomination of the coins are

recognized on the basis of their radii[1]. The circle pattern is governed by the following equation which is given as

$$(x - a)^2 + (y - b)^2 = r^2$$

A circle was defined by the following parameters used in the above equations such as x and y are the directions, a and b used as the co ordinates and r for the radius. Various set of images were computed by the above technique. The success rate of the detection and recognition was upto 94 % as defined by the author and result using this technique is shown in Fig 2

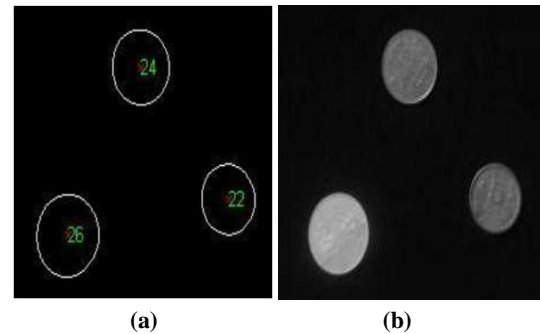


Fig 2: Result using CHT: (a) Sample Image of coin (b) Result of computed radii

#### 3.2 Artificial Neural Networks

In this paper author proposed artificial Neural Networks (ANN) in order to detect and recognize the coin in an image. This can be done by extracting the features by using the pattern averaging and various other techniques such as HT. Here the recognition was done by dividing the recognition process into variety of steps. Result using ANN[2] shows in Fig.3.

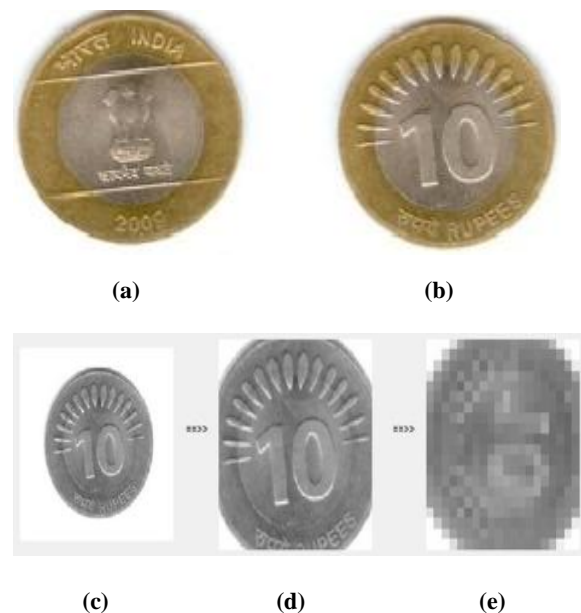


Fig 3: Result using ANN: (a)-(b) Original Image , (c) After removing shadow (d) Cropped Image (e) Pattern averaging Image

#### 3.3 Hough Transform

The objective of the hough transform is to detect the coin in an image .The HT algorithm which is applied in order to

detect and recognize the edges generated in an image which may include a straight lines or the curves. The HT is considered to be very robust technique when an image is prone to noise or an image is cluttered [5]. HT provides with the perfect image when is to be recognized and detected. Choosing of parameters is the basic requirement of using an technique. HT provides with the detection and recognition on the basis of real system such as recognition rate, low cost system, recognition time should be very less. HT with the three features above provides with the 100% edge detection.

### **3.4 Heuristic Approach**

The approach above is to design coin recognition by applying heuristic approach which uses the coin table. This approach used the various parameters such as shape, area, weight, average gray value, thickness etc. The coin detection are well recognized by zooming or the de-zooming by which the size of the image can be increased or decreased. It concentrates on the gray value images then moving on to thresholding transformation sets of grey value. Extracting the features by segmentation then classifying the coin which is detected and recognized. The above approach which yields the result of detection and recognition of an image of about 97% based only on the coin table.

### **3.5 Registration Technique**

The author proposed a coin detection and recognition on the basis which is totally dependent upon the directions of the gradient vectors. The detection and recognition of the coins done here with full accuracy in a very small amount of time[6]. The classification is based upon the thickness and the radius. The images of coin captured from the both sides. Similarity occurring between the images was computed by using the registration technique. The number of the translation poses of the coin was determined by the algorithm of segmentation where the radius and the centre of the coin was mainly focused. When using registration technique focus is not on the color of the image whether it is bright or dark but the basic part was to identify positive and negative direction. All the possible sizes of the coin can be used. Registration technique which make use of the canny filter used to detect the image the edges but the unwanted images are removed. Canny edge detector which always act an powerful tool but this filter again depend on certain set of parameters. Identical coins are detected and recognized.

### **3.6 Vector Quantization and Histogram Modelling**

The recognition of the tail side of the coin is done by using the vector quantization. Vector quantization which is concerned with the data compression. The basic focus is given to the texture of the coin rather than the color of the coin . This basic techniques involves the basic steps like collection of data ,segmenting , cropping, extracting the feature then to training and testing of an image used for the recognition. Histogram which further used for recognition and this recognition is totally based on graphical representation. It basically depends on the image pixel value .These both methods used to detect and recognize the image of coin very

deeply by reading each pixel value using vector and histogram. These technique performed very well under testing of an image when it is lighting or the orientation. Around 200 images can be tested and the accuracy yielded was for about 94%[7].

### **3.7 Sensors**

The author presented the implementation of two euro counterfeit detection of coin [9]. The detection and recognition of coin is dependent upon on the image acquisition. The system uses the high resolution camera with the parameters such as size, thickness, weight etc. The two detection system were proposed and tested. First which involved the squal register involving rough information in it. Further images acquired by the optical mouse sensors are used as duplicate copies which further compared with reference images. The number of the coins valid are rejected when the coins are taken from other countries. The basic of using optical mouse for sensing an image is the inexpensive cost.

### **3.8 Dagobert**

In this paper the author proposed a pattern recognition methods for the recognition of the coins [10]. The coins which are further sorted and identified by using the technique known as dagobert. This technique helps in the verification and the rejection of the coins. The recognition methods which is further divided into three parts such as coin detection, coin pre-selection, coin verification. These methods involves the use of the parameters such as the thickness or diameter of the coin used. The results showed that the system is able to detect large volume of coins using dagobert. The detection and recognition of coins were done and separated when taken from various countries.

## **4. LIMITATIONS**

The detection and recognition of coins of different denomination done by the different authors by using various techniques have many limitations that are need to be solved are defined below:

1. The coin image is captured from the distance and the image tends to be small.
2. Difficult to Recognize in adverse conditions.
3. When the recognizing system is not able to detect the non-coins.
4. Need of rotating the coin.
5. Problem of low speed when dealing with the large size image.
6. Overlapping of coins.

## **5. CONCLUSIONS**

The authors presented the detection and recognition of the different denomination and large volume of coins using the various techniques as discussed. All techniques resulted in the detection and recognition process but with the limitations. The work was on the recognition but not with the recognition of partial and fully overlapped coins. Future work can be done on the recognition of any type of overlapping.

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