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Morphological Technique for Improving Indian Coin Detection System under Varying Lighting Conditions

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Abstract: We proposed a method for Indian coin detection under varying lighting conditions. The basic idea behind our method is to extract features of known coins and put in a database. And when a new coin is entered its features are compared with the images of the coin that stored in the database. We trained our system under different lighting conditions. We assumed different lighting intensities, which occurs due to various reasons such as power fluctuations. We tried to detect Indian coin value under these conditions. This work basically involved automatic detection and recognition of Indian coin using morphological operations of image processing. Image processing is a process in which an input image is transformed into digital image form and performs some operation on it, In order to get high image property and to extract some useful information from it. This work is a prototype simulation and a proof of concept. The application of this work ranges from simple vending machines to automatic mobile recharging. In this thesis, we use MATLAB based simulation to obtain our result.

Keywords: Edge detection, Segmentation, Thresholding, Edge enhancement, Features extraction, Patter matching.

I. INTRODUCTION

The ability to recognize the value of different forms of currency is a necessary skill in the everyday life of most human beings. In order to automate monetary transactions, it is necessary to enable computers to perform such recognition as well. Towards this end, we created a system that could correctly identify coins.

Banks uses bill counting machine to enumerate the money. But when the customer wants to pay a large number of cash into the bank, bank staffs may make mistakes to calculate the total value and number of one rupee, two rupee, five rupee, and ten rupee coins used. Some coins from different foreign currency look similar. So sometimes it is difficult to distinguish them by using human eyes, especially for large amount of coins. Besides this, because of the globalization, the banks often receive foreign currency that the staff may not recognize. The charities face the same situation as the bank, because the donators come from all over the world. So it is necessary to develop a system that can help them to recognize and calculate the money that they receive [1].

Many researchers have used morphological operations for Indian coin value detection. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours**.** Many researchers have used morphological operations for Indian coin value detection. Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to grey scale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest[3]. So we propose method for Indian coin value detection by morphological technique under varying light intensity and standard distance between coin and webcam. However they assume that the condition of the lightning on the coin is not uniform. So we tried to detect Indian coin value under these varying light conditions.

II. LITERATURE REVIEW

There are various approaches proposed by various researchers for image based coin recognition.

According to [1], the author Malatesh M, B.N Veerappa, Anitha G (2015) wanted to improve the problem of efficiency of detecting Indian coin. The user proposed a method for coin recognition consists of image acquisition then he used image segmentation, edge enhancement, edge detection, blob measurements and finally count the total value of the coins. The most appropriate computation

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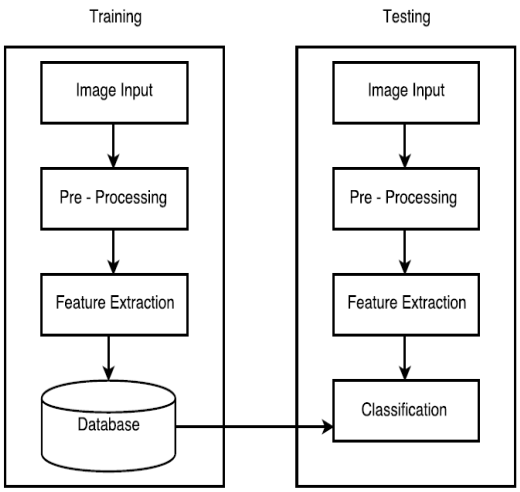
strategy used in this paper should be graph matching. According to this strategy, the coins should be classified into different groups by their features. The features used in this paper could be the colours and the radiuses. The result of [1] was that recognition of coin using morphological operations shows positive signs for coin identification. He used image segmentation as the first step which reduces total time requires executing the program. Then he did Edge enhancement that provides the clear edges of the coins to improve accuracy for coin detection. Finally, he finished with blob measurements which are provided to give precise results.

According to author [2] the author Shivanand S.Rumma (2015), their research objective was to develop an automated system using morphological recognition algorithm. In which image is captured by the camera and converted into gray scale image for pre-processing. After conversion, image complemented, binary conversion is applied on the image. After conversion canny edge detection method has done and passed this detection to the dilation process. After filtration and dilation, the area is selected where a number of coins are maximum and coins are recognized from the image in the form of the bounding box. Blob analysis is used for each coin separately to detect Indian coins. The result of [2] this proposed approach is an automated system developed in MATLAB R2013a for using the different technique from previous work, this paper used canny edge detection method for detecting the coins using blob analysis.

III. PROPOSED METHODOLOGY

There are various approaches proposed by various researchers for image based coin recognition. The following flow chart shows basic steps in our proposed method:



As the above flowchart shows the system is divided into two parts training and testing, in training phase the database is constracted while testing is used to classify a new image.

Our system comprises of two basic steps. One is training and another is testing. In training phase known coins are provided to the system. The features of these known coins are extracted and are stored in a database.

During testing phase an unknown coin is input, and its features are extracted. Then the distance between these features and those stored are compared. The coin is recognised based on the closeness with one of the stored features.

During training phase, we also provided coins under different lighting conditions. Thus our system was trained to handle varying lighting conditions. We considered following features:

1. Size (radius)
2. Texture (GLCM)
3. Colour (Colour moments)
4. Edge Histogram

Let us now discuss each step in detail:

A. Phase 1: Training
Step 1: All the images names in folder, where this file is placed, with '.bmp' extension are stored in files.
Step 2: The following steps are applied on all the images one by one.
Step 3: The images is read using imread command.
Step 4: To make all images of same size the image is resized to 128x128 dimensions.
Step 5: The coin is segmented using segmentImage.
Step 6: The binary image created is used to calculate diameter of coin.
Step 7: Features of coin are calculated using totalfeeature and stored in curreny structure in feature field.
Step 8: The image name before the '-' is considered as the image label and saved in curreny structure in name field.
Step 9: Radius of the coin is stored in curreny structure in radius field.
Step 10: The currecy variable is saved in 'data.mat' file.

B. Phase 2: Testing
Step 1:Show input dialog box and record file name and path.
Step 2: Read specified image using imread.
Step 3: Resize the image.
Step 4: Segment the image.
Step 5: Calculate its radius.
Step 6: Load the database.
Step 7: Read all the radius in the database.
Step 8: Check if the radius of given coin matches the one in database +/- 'th2'.
Step 9: If the radius is not matched display "not a coin' and exit else execute following steps.
Step10: Calculte image features using totalfeatures.
Step 11: Calculate euclidean distance of feature of image with ones in database.
Step 12: Find the feature index having minimum distance.

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Step 13: If distance id less than specified threshold th diplay the Label corresponding to that feature.
Step 14: Else diplay 'No match found'

IV. ANALYSIS

These images shows analysis of our system under varying lighting conditions. This section shows screenshot of various process:

Figure1: Input images of 1INR, 2INR, 5INR, 10INR coins

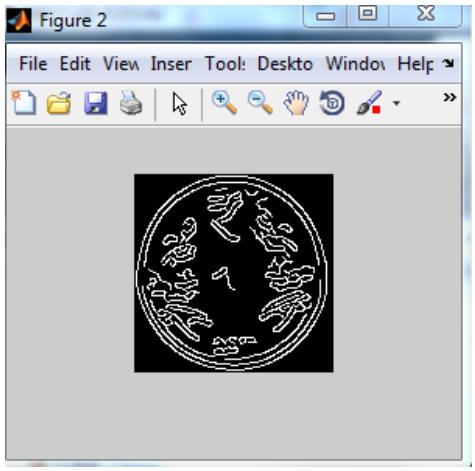

Figure 2: Edges of front 1INR coin after training

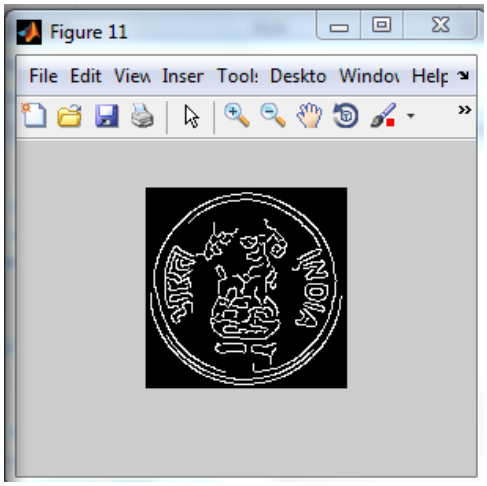

Figure 3: Edges of back 1 INR coin after training

Now we shows some images that we used in testing phase

Figure 4: Images of coin for testing in three conditions a) darker, b) lighter and c) fake

It can be seen that many of the testing images are visually very different from the one we used during training. But our system was able to extract distinguishing features, and classify correctly in many cases.
Below snapshot illustrate the result upon correct recoginition and we got the following message box displayed:

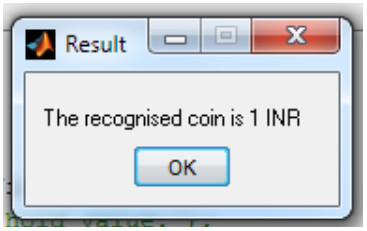

Figure 5: GUI of detection of 1 INR coin

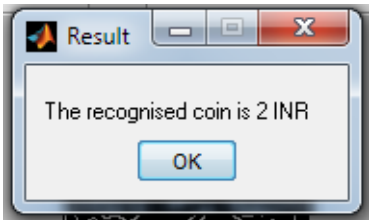

Figure 6: GUI of detection of 2 INR coin

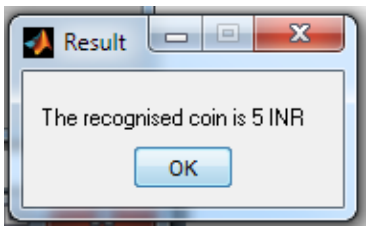

Figure 7: GUI of detection of 5 INR coin

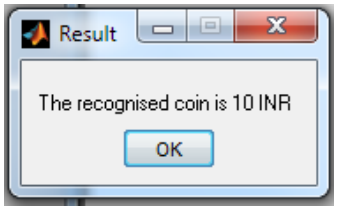

Figure 8: GUI of detection of 10 INR coin

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C. Fake Coin detection

The system is able to detect fake coins, even if its radius is same as that of a genuine coin. This is because w is not relying only on radius, but we are also searching for various features: Histogram of Edges, Colour moments, texture using GLCM.

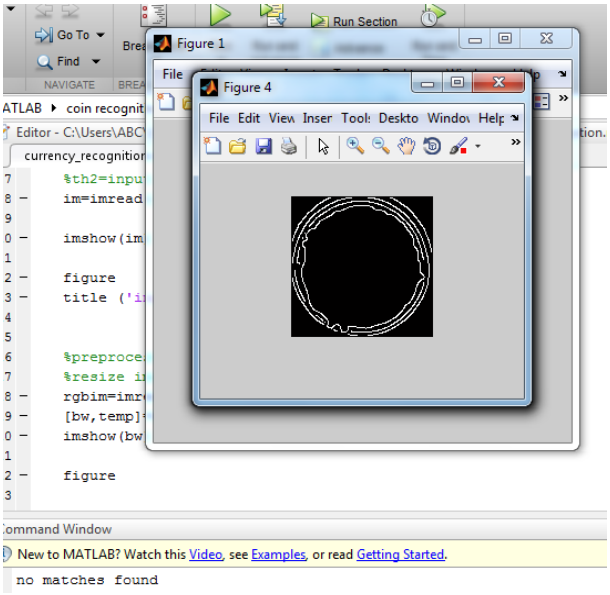

Figure 9: Detection of fake coin

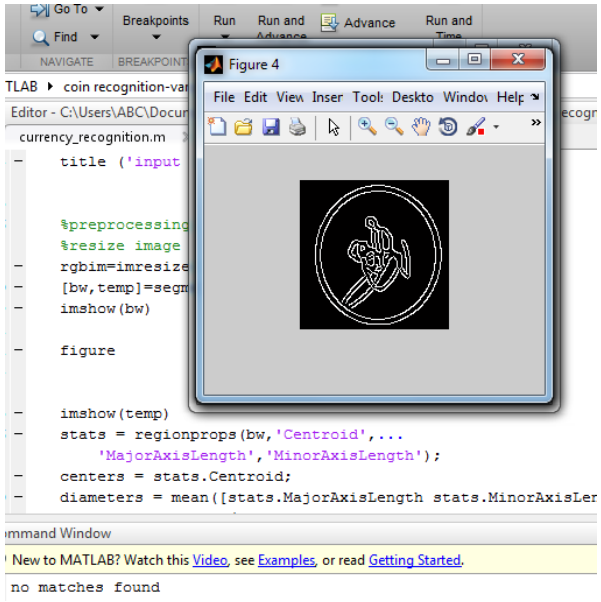

Figure 10: Detection of fake coin

V. SUMMARY OF RESULTS

Under same lighting condition, the system is able to differentiate between different value coins. Once we change coins (i.e. use another Rupee 1 coin, instead of the one used in training), almost 95% efficiency was achieved.

Under varying lighting condition, we observe the following:

1. If during testing the lighting was exactly same as that used during training. The system worked 95% of the time.
2. If during testing the lighting was increased up to 30% as compared to that used during training. The system worked 93% of the time.
3. If during testing the lighting was decreased up to 20% as compared to that used during training. The system worked 85% of the time.

VI. CONCLUSION AND FUTURE SCOPE

The Indian coin detection based on feature extraction was implemented in this work. We found that the performance was excellent when the tested coin is put under same lighting condition as that during training phase. We found that colour moments in L, U, V space provided capability required for light invariant detection. Thus even when we input coins with new lighting condition, our system worked in a reasonably good way.

The system's performance can be further increased by using Artificial Neural Network for training with extracted features. Further, we should take much larger sample space to come up with better training features.

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