VISUAL-BASED AUTOMATIC COIN COUNTING SYSTEM

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ABSTRACT

Coin counting has been a practical issue in various financial transactions. Before the arrival of coin counting machine people used to count the coins manually. This is a very time consuming and tedious job for those who handle the work. Mistakes are common due to various reasons such as; eye tiredness, fatigue, too many coins cause confuses in eyes and etc. In this paper a visual-based simple coin counting system is described. This system performs its task by using an image captured from a webcam. Image processing techniques such as gray image conversion and thresholding to a binary image were employed. Classification of coins based on value was done by analyzing statistical properties and connected components. The results show the effectiveness of the algorithm in evaluating the coin counting.

***Key words*:** gray image, binary image, connected component

1. INTRODUCTION

Coin counting has been an issue for bank and store. Before the arrival of coin counting machine, man has to count the coins manually, and it is time consuming and yet tedious for those who handle the counting work. Mistakes can happen most of time due to many reasons such as, eyes tiredness, losing focus, too many tiny coins may confuse the eyes and etc. New coin-counting methods need to appear and was essential because an accurate coin-counting is able to provide a quantitative output and time saving. Various methods that use microcontroller based approaches are in use have electronic and mechanical components as well. On the other hand several image based techniques use pixel density estimations to find the coin counting [1]. Additionally some vision based techniques uses classification methods such as multilayer feed-forward neural networks, Radial Basis Function neural networks [2], [3].

In general, vision-based systems are performed in two stages: The first is image processing and later image understanding. The first is to isolate the objects of interest or coins from the background. This followed by feature extraction technique which extract the statistical properties such as area of the isolated coins. In this paper, we describe a simple vision based coin counting system to perform accurately and efficiently. The main issues discussed in this paper are the technique to extract essential features from unconstrained images using simple image processing methods which makes the system fast.

Also we employ the approach of image segmentation and feature extraction that use statistical properties of the segmented areas. These areas are then compared and finally the coin count will be given.

The paper is organized as follows. Section 2 briefly explains the methodology we use; Section 3 deals with the results obtained, Section 4 presents the conclusion.

2. METHODOLOGY

For the application domain, the coin counting system performs in two stages: image processing, and image understanding. For this task, images of coins are captured using a video capturing device in RGB 256 colors against a white background.

Few assumption have been made in order to make the project much simpler such that coins are placed where there is no overlapping or occlusion of coins, and also the coins may not be touching as well.

All coins are photographed from the same height in order to keep the same defined area proportions. Hence two coins of the same type are identical or almost identical in size in one given photographs. The Fig. 1 shows the main components used in this system.

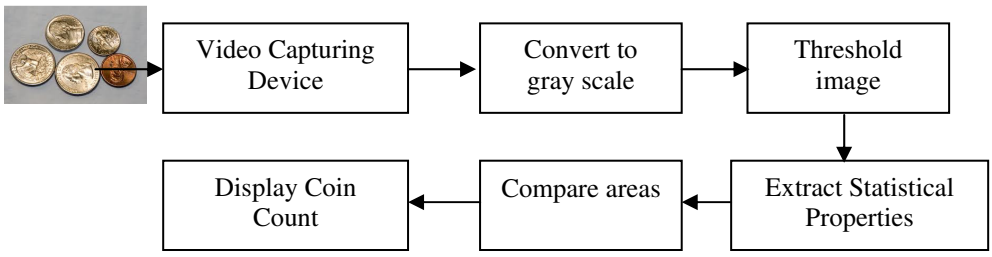


Fig. 1: Overview of the Vision based coin counting system

In this project we have considered only three classes of coins in Sri Lanka. This can be shown as in Fig. 2. They are the five rupees coin, two rupees coin and one rupee coin.

(a) Five Rupees Coin

(b) Two Rupees Coin

(c) One Rupee Coin

Fig. 2: Three Classes of coins used in the project

A. Convert to gray scale

One of the simplest and often most effective ways to get the color out of a color photo is to convert it to Grayscale. This reduces computational complexities arise from color images. If $f(x, y)$ is a gray scale image, and $f_R(x, y), f_G(x, y), f_B(x, y)$ are the red, green and blue channels of the color image respectively, the conversion can be represented by,

$$f(x, y) = w_1 f_R(x, y) + w_2 f_G(x, y) + w_3 f_B(x, y) \quad (1)$$

Where $w_1 = 0.2989$, $w_2 = 0.5870$ and

$w_3 = 0.1140$

B. Select a threshold Value

Selecting correct threshold is very important to optimize the binary image to have minimum background noise and coins with as few holes as possible. This will depend on the lighting conditions used for the photograph. Initial calibration is needed. But once the system is set up we can assume the lighting will remain approximately the same. Small variations should not be a problem.

C. Remove holes from the image

Presence of noise in the background may result in spurious objects. Also the circles generated for coins may not be solid and may have holes in it.

They may also be surrounded with noise that may remain even after applying a filter. The noise may be of any arbitrary shape and may lead to a partially deformed coin. Morphological operation flood-fill will be a good method in order to remove holes in binary images.

D. Remove Noise

Applying a median filter on an image is an expensive operation, although the salt and pepper noise reduction in the image of coins seemed to be very good. A 3x3 mask median filter was applied on the coin images.

E. Finding area

This can be considered as the actual number of pixels in the selected connected components. In general, the area of a region can be calculated by,

$$A = \iint_R f(x, y)dxdy \qquad (2)$$

Where the integration is performed over a region of interest R .

3. EXPERIMENTAL RESULTS

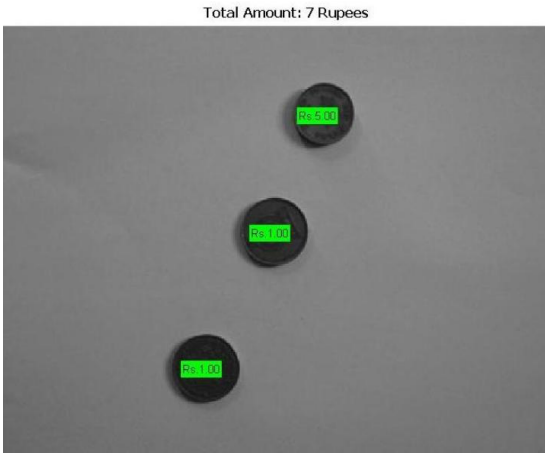
C. Setup

In this experiment a webcam was selected as a video capturing device. The frame size was set at 640×480. For this experiment, to keep the captured coins at same size, camera is fixed at a constant height. And the method can work at a frequency of 10fps.

D. Results

(a) Total amount of Rs. 11.00

(b) Total amount of Rs. 5.00



(c) Total amount of Rs. 7.00

(d) Total amount of Rs. 3.00

Fig. 3: Calculated total amount

4. CONCLUSION and DISCUSSION

In this paper a coin counting system has been developed based on basic image processing techniques such as color to gray image conversion, thresholding, filling holes in binary image. Classification of coins based on value was done by analyzing statistical properties and connected components. There are several developments to be done in order to increase the accuracy of the system. The first thing is the system must be robust to find the values at different scales or in other words at different heights of the camera. And also the system should be able to find value for more classes of coins such as coins appear in different shapes and sizes.

5. REFERENCES

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