AUTOMATIC BALANCE PROVIDER

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Abstract – Rupee Note is the basic requirement in day-to-day life which are used everywhere. The Rupee Notes are in the denomination ₹10, ₹20, ₹50, ₹100, etc. and the coins are in the denomination ₹1, ₹2, ₹5. It is not sure to get the exact amount for the product while purchasing. It may be a difficult task for the shopkeeper to search the coins and provide the balance to each and every customer. This is the main purpose of designing such a machine. This machine designed for providing the balance amount in coins automatically to the customer. This machine captures the image of the note provided by the customer and the value of the note determined using image processing technique. The Image Processing is done with the help of Python OpenCV.

Key-Words: Arduino, Python, Brute Force Method, Image Processing, Micro-controller

1. Introduction

Paper currency note is one of the most prevailed medium of daily transactions in many or almost all the countries in the world. Each Indian Currency Note has its specific dominant color and special common features prescribed or specified by RBI. By Extracting the features from the currency note, the value of the currency can be detected. The Payment amount is got from the user and required change is given. In our project the payment amount must be within Rs.50 and the rupee note given must be of Rs.10, Rs. 20, Rs.50. The change can be of coins Re.1, Rs.2, Rs.5, Rs.10.

Fig.1: Hardware – Automatic Balance Provider

Using this machine, it reduces the man-work of the shop-keeper and the exact balance can be provided to the customer.

A. Image Processing

Image Processing is the method of processing in an Image. The features of an image can be extracted and is used for processing. Image Enhancement can also be done using Image processing. In our project, the image of the rupee note placed by the customer is captured by a camera and sent for
Image Processing, by using Image Processing; the value of the rupee note is detected. There are many methods for processing an Image, in our project, Brute Force method is used for processing the image.

B. Brute Force Method

Brute Force Method is one of the methods used for Image Processing. This algorithm uses feature matching for detecting the value of the rupee note. The Brute Force method is carried out using python. Python OpenCV is used to perform OpenCV method. In this method, the captured image is made into a number of sample sets and compares each set with the image stored in the database, and returns the number of successful matches. Image can be identified using edge detection, edge detection is carried out using SIFT algorithm (Scale Invariant Feature Transform). This algorithm extracts the key-points of the image and detects the descriptors. The SIFT algorithm uses four steps for determining the key-points: Scale-space Extrema Detection: Same size windows can’t be used for detecting the key-points of an image. So, Laplacian of Gaussian (LoG) is found for the image. \((x,y,\sigma)\) is found which means that there is a potential key-point at \((x,y)\) at \(\sigma\) scale, where \(\sigma\) is a scaling parameter. The Difference of Gaussians (DoG) is used as LoG is costly. DoG is an approximation of LoG.

C. Key-point Localization

By the above process, we can get the potential key points. But for accurate key points, Taylor series expansion of scale space is used. The principal curvature is calculated using 2x2 Hessian matrix \((H)\). For edges, one eight value must be larger than other. If the ratio is greater for a key point, then the key point is neglected. Only accurate key points are available now.

D. Orientation Assignment

This step is to achieve invariance on rotation of image. It is done using the neighborhood key points based on the calculation of gradient magnitude and direction.

E. Key point Descriptor

A 16x16 neighborhood around the key point is taken. It is divided into 16 sub-blocks of size 4x4. Total 128 bin orientation histogram is created from the 4x4 sub-blocks which each takes 8 bins. It is represented as a vector to form key point descriptor.

![Fig.2: Block Diagram of Automatic Balance Provider](image-url)
F. Microcontroller

The Microcontroller used for our project is Arduino. Arduino is used to instruct the motor to actuate the arms. A Motor Driver is used to provide additional power to the DC Motor. Motor Driver is connected to the Arduino and the DC Motors are connected to the Motor Driver.

G. Coin Holder

Three PVC Pipes are used for holding the coins. A small gap is left at the bottom of the pipe to knock the coins out one by one. A knocker is attached to the DC Motor to knock the coins present in the PVC Pipe.

Components Used

- **Hardware:** Camera, Arduino Board, Laptop with Python IDE installed and Arduino IDE installed, DC Gear Motors, Motor Driver, 5v Relay, PVC pipes (for holding coins).
- **Software:** Python IDE (PyCharm, Idle, etc.), Arduino IDE.

Algorithm – 1. Place the rupee note in the note placing unit.
2. Capture the image of the rupee note using camera.
3. The captured image is processed.
4. The value of the Rupee note is detected using Brute Force method.
5. The number of coins to be given to the customer is detected.
6. The detected number of coins are sent to the Arduino using Serial Communication.
7. The motor is connected to the Arduino using Motor Driver and 5v Relay.
8. The Arduino actuate the motor to knock the coins into the coin collector according to the signal received by the Laptop.

Fig.3: Flow Process

Fig.4: Feature Matching
2. Conclusion
Analysis of currency note is easier using Image Processing compared to other technologies. It helps the small scale shop keepers to provide change without any stress and fault. Man-Work can be reduced by implementing this project in small-scale shops. By adding some additional features, shop-keeper less shops can be provided.

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