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Fake Indian Currency Detection App

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Abstract

To identify counterfeit currency and report on the findings. Using a mobile camera, the model accepts the photograph. The extracted features from the scanning image are compared to a series of models. When a match is found, the outcome is outputted, indicating whether the match was true or not. Image resizing, image filtering, sobel edge detection, and template matching are the four algorithms used in this article. Even though printing false currencies is unlawful, counterfeit currencies continue to circulate in areas where there are no forms of verifying the currency's validity. The aim of this project is to avoid illicit notes from being distributed further. The project's aim is to identify false or counterfeit currency. It is accomplished by taking a sequence of steps in the same order each time. To begin, a cell phone is used to capture a picture of the currency note (camera). Second, the captured image is resized to or scaled down to 500 x 300 pixels. After that, a bilateral filter is used to eliminate noise from the signal. The features that determine a currency note's validity are then detected using the sobel operator. Correlation regression is used to match the characteristics of the note to those of an authentic note. Finally, features are listed and shown for the genuine note.

Keywords: *Template Matching, Bilateral Filtering, Sobel edge detection, OpenCV, Canny edge detection*

1. Introduction

The standardised unit of exchange is currency. The counterfeiting of currencies is a normal occurrence. Money is a fictitious currency that does not have the central government's legal approval. It is normally done to mislead a third party by falsifying money. Forgery or fraud is described as the creation or use of counterfeit money. Counterfeiting for financing terrorism has become desirable to terrorists because it is very lucrative, particularly as opposed to the costs associated with other illegal activities. Currency counterfeiting for the purpose of financing terrorism is only found in some areas. The impact of counterfeit currencies on society can involve a decrease in the value of money and market increases because of more money being exchanged in the economy. Counterfeit money is a danger to a country's economy. As technology progresses on a regular basis, the rate of counterfeit notes grows in lockstep. Therefore, there is a need to track currency counterfeiting. The hardware-based approach is very costly. Grey scale conversion, edge detection, attribute extraction, and pattern matching are also part of the automatic software used to detect counterfeit notes. As a result, incorporating algorithms reduces the cost of buying the hardware used to determine if a note is authentic or not. This approach can be used not only in banks, but also in small retail stores that can be extended to a wider scale in the future. We have referred around 12 technical papers in total. From the initial papers, we were able to detect different objects on the currency. The latter papers gave us an insight on image processing, grey scale conversion and sobel edge detection by superimposing the x and y kernel to output an image from which we could determine if the note is genuine or fake.

Literature Survey

In this section we performed the rigorous literature survey on Smart Parking System carried out during last four decades. However, we listed here very few for discussion. The research discussed in [1] focuses on identifying counterfeit notes using sample photographs. A notice image is represented in a dissimilarity space created by contrasting it to a series of prototypes. SIFT (Scale-Invariant Feature Transform) detector was used to identify the key points. The downside was that this approach could only be used to classify objects on an image, not to compare pictures. The identification of paper currency was the subject in [2], which was automated. Digital image recognition methods were used to identify paper money. The feature extraction is done on the sample picture and compared to the genuine currency models. The sobel operator was used to remove the functions. Reference [4] used a correlation strategy based on template matching. This approach circumvented the problem of matching several items at once. It entailed matching the original image to the sample prototype image. To reduce the rendering complexity, the prototype and initial image are translated to grey scale. After that, the photos were compared using the sliding window technique.

Picture detection was used to detect currency in a method proposed in [8]. A scanned or photographed image was used as the input. The performance would decide whether the note was true. The technique included image pre-processing, grey-scale conversion, edge detection, segmentation, attribute extraction, and comparison. The fundamental idea behind the sobel operator was introduced in [9], which is used to locate the different edges of images that have been processed in both the XY directions. A matrix known as a Kernel matrix was used in this. For XY directions, the kernel matrix is already predefined. On scanning XY directions, we get XY kernels respectively. The identification and authentication of different security features and watermarks in [10] provided a brief idea of whether all the security features of a note currency should be balanced to discern whether a given note is genuine or false. The identification of a green strip on the note and Mahatma Gandhi's secret picture on the note may be security features.

Theoretical Background

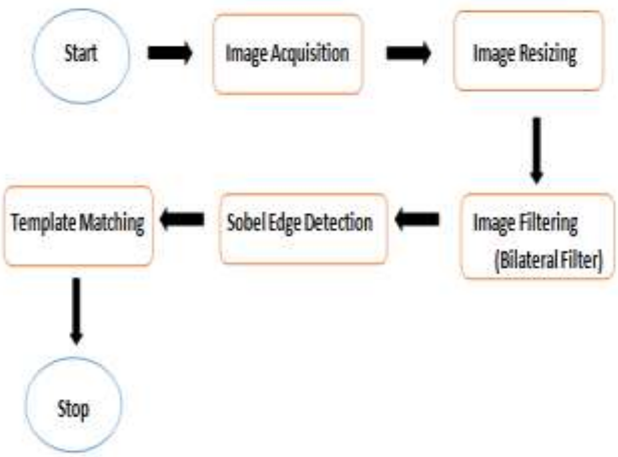


Fig 1: Basic Image Processing

A method to detect fraud currency of Indian notes is built in the proposed work. To start, use a webcam or a mobile scanner to capture the provided image and pre-process it with image resizing and filtering. Apply the Sobel algorithm for edge detection and prototype matching after pre-processing to detect different features on the note currency. The primary features which are used by the RBI to differentiate between authentic and counterfeit notes are not completely detected using other edge detection algorithms. This is done in a fast and efficient manner using Sobel Edge detection as it does not have multi-stage process like Canny edge detection algorithm. The way Sobel-Edge Detection works is the result is produced by overlapping the result of the Sobel Operator – which includes two sub-divided functions – The Sobel edge detection algorithm provides an approximation to the gradient magnitude and can detect the edges along with their orientations. But these features are not enough to qualify a note to be authentic and can be detected on xerox copies of authentic notes as well. The following are some of the algorithms that were used:

A. Image Resizing

The initial scanned image is resized using an image resizing algorithm to a particular dimension or resolution. To process all of the images in the fixed dimension, the resolutions for all of the images have been set to 500 X 300.

B. Image Filtering

There are different distortions or noises in the scanned file. Smoothing the picture is needed to eliminate these noises. The BILATERAL FILTER algorithm aids in the reduction of noise in scanned notes. The intensity value of each pixel is determined by replacing it with the weighted average intensity value of the adjacent pixels in a bilateral filter. The weights can be determined by Euclidean distance, range disparities, and pixel depth distance.

C. Sobel Edge Detection

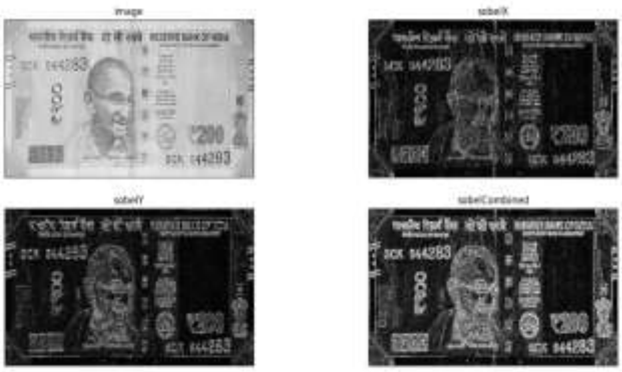
Edge detection is used for locating different target boundaries within images. It works by detecting different brightness discontinuities in the image. In sobel edge detection image is refined in XY directions and the outputs are superimposed. In sobel edge detection, the image is firstly converted from RGB colour channel to GRAYSCALE image. Here the image is stored independently in the XY directions, then the images from both directions are merged to create a new image which is a combination of the XY directions. The image is first transformed from RGB colour channel to GRAYSCALE image in sobel edge detection. The Kernel convolution, which is a 3 X 3 matrix with symmetrically weighted indexes, is then estimated. The XY Path kernel will be used to scan in the XY direction respectively.

X- Direction Kernel

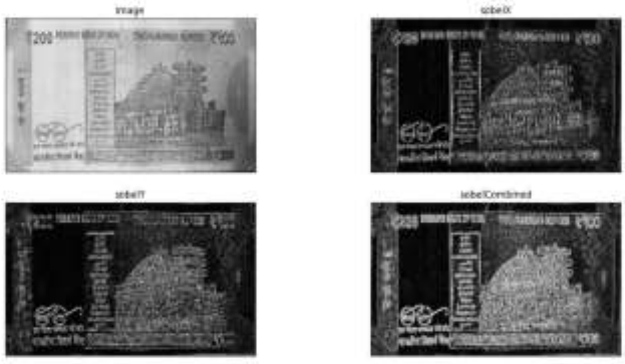
-1	0	1
-2	0	2
-1	0	1

Y- Direction Kernel

-1	-2	1
0	0	0
1	2	1



(a)



(b)

Fig 2: Sobel Edge Detection

(a)Front part of the note (b) Back part of the note

D. Template Matching

It's a computer vision (OpenCV) technique for detecting similarities between two images. It's a way of identifying the template image inside the larger image. Template matching is achieved using the OpenCV feature cv2.matchTemplate(). It contrasts the template and the patch of main image underneath the template image by moving the template image over the main image. Then it returns a grayscale image, with each pixel indicating how closely the neighbouring pixels match the prototype. Following that, the function cv2.minMaxLoc() is used to locate the maximum or minimum value. For template matching, the correlation coefficient cv2.TM CCOEFF (correlation coefficient) is used. The template matching algorithm in turn uses Canny Edge Detection Algorithm and its value is used in the cv2.matchTemplate() function. The cv2.TM CCOEFF formula is:

$$R(x,y) = \sum_{x', y'} (T'(x', y') \cdot I'(x+x', y+y'))$$

in which,

$$T'(x', y') = T(x', y') - 1/(w \cdot h) \cdot \sum_{x'', y''} T(x'', y'')$$

$$I'(x+x', y+y') = I(x+x', y+y') - 1/(w \cdot h) \cdot \sum_{x'', y''} I(x+x'', y+y'')$$

Where,

x : pixel along x-axis

y : pixel along y-axis

x' : first pixel after x

y' : first pixel after y

x'' : second pixel after x

y'' : second pixel after y

w : width of template image

h : height of template image

$R(x,y)$: sum of all elements in the Matrix

I : source image

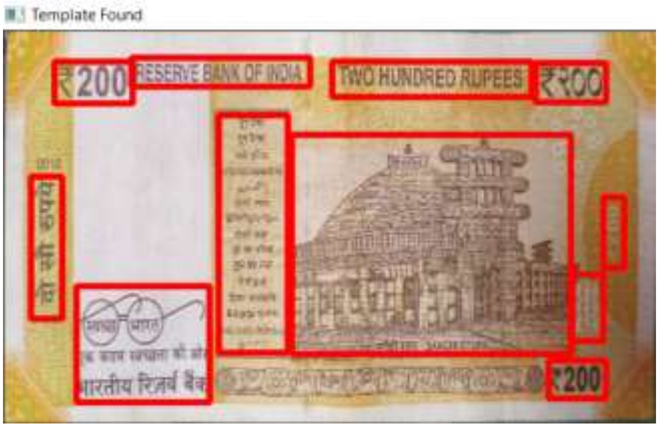
T : template image

I' : resized source image

T' : resized template image

Following the discovery of the template, a rectangular box will be drawn on the main image, which will act as the template's field.

(a)



(b)

Fig 3: Template Matching

(a)Front part of the note (b) Back part of the note

E. Canny Edge Detection

The Canny detector helps to eliminate the noise at the image, is through making use of Gaussian blur to clean it. The Gradient calculation step detects the brink depth and course with the aid of using calculating the gradient of the photo the usage of facet detection operators. Edges correspond to pixels depth. To locate it, the perfect manner is to use filters that spotlight this depth in each pixel. We ought to carry out non-most suppression to skinny out the edges. The set of rules is going via all of the factors at the gradient depth matrix and reveals the pixels with the most cost with inside the facet directions. High threshold is used to perceive the sturdy pixels. Low threshold is used to perceive the non-applicable pixels. All pixels having depth among each threshold are flagged as susceptible and the Hysteresis mechanism (subsequent step) will assist us perceive those that might be taken into consideration as sturdy and those which can be taken into consideration as non-applicable. Based on the brink results, the hysteresis includes remodelling susceptible pixels into sturdy ones, if and most effective if at the least one of the pixels round the only being processed is a sturdy one.

F. Kivy Module

Kivy is an open-source Python library with a graphical UI that allows you to make cross-stage programming for Windows, macOS, Apple, iOS, Linux, and Raspberry Pi. It additionally permits multitouch occasions notwithstanding mouse and console inputs. The applications made with Kivy will appear to be identical on all gadgets, however they won't have a similar vibe or look as local applications. Kivy enables you with the opportunity to compose your code once and have it run as-is on various platforms. Creating Kivy applications is fun and rewarding. Kivy is the solitary answer for coding in Python on cell phones. It is likewise fit for running on numerous stages like HTML5 on the grounds that it doesn't rely upon weighty program support and is carried out in C utilizing Cython because of which it runs straightforwardly on the GPU. The fundamental point that was remembered while creating Kivy was to run similar code on different stages. It contains every one of the modules for building applications, for example, illustrations library, multi-contact backing and Kivy Language. There are two principal conditions for Kivy to run on your framework: Python and Cython.

3. Results and Discussion

As we all know that edge detection is a technique of image processing used to identify points in a digital image with discontinuities, that is, sharp changes in the image brightness. The points where the image brightness varies sharply are the so-called EDGES which need to be detected. Although there are many edge detection algorithms like Sobel Edge Detection, Canny Edge detection, Kirsch Edge Detection and so on, the one that is better in comparison is Sobel Edge Detection. Kirsch Edge Detection is a non-linear edge detection algorithm which is used to determine the maximum edge strength and Canny edge detection uses multi-stage algorithm to detect wide range of edges. Both the algorithms fail to detect the important features which qualify a currency note to be authentic – security thread, watermark, and the latent image of denomination. This project depicts the recognition of counterfeit note using image processing. This helps the users to identify the original notes in an easier and faster way. The identification of counterfeit notes is represented in this project using image processing and Python. We used methods like image pre-processing for enhancing the appearance of scanned images, binarization for transforming RGB image into grey scale, edge detection (sobel), image segmentation for extracting the features in a simplistic version, and then compared to distinguish original or false notes in this project. This makes it simple and fast for users to recognize original notes.

4. Conclusion

This project on image processing for fake currency identification is based on edge detection using the Sobel operator. The OpenCV package was used to write the whole code in Python. The image of the currency note is first captured, then the image is resized to the correct size (500x300). To eliminate noise from the resized image, it is subjected to bilateral filtering. The borders of different models are defined using Sobel Edge Detection. Finally, we use the cv2.TM CCOEFF correlation coefficient to equate the established features in the test picture to the real features in a valid note. This device can be used in areas where money is exchanged, such as banks, ATMs, and supermarkets. This initiative not only recognises the various currencies of Indian currency, but it also looks for false or stolen notes. It can also be developed to recognise the currencies of various countries, as well as their denominations. The primary aim of this initiative is to support the visually disabled with their money transactions by aiding them in identifying Indian currency denominations. This project is very strict in distinguishing currencies in their note type. As a result, coins cannot be found [13-18].

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