COUNTERFEIT CURRENCY DETECTION USING TEMPALTE MATCHING ALGORITHM

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Abstract : ***As an improvement in technology beyond the past has led to more circulation of fake currency in today's economy. So need to implement such a technology to overcome the counterfeit currency issues. Here template matching algorithm is used for checking the counterfeit currency. Firstly extract the feature from original currency then select another currency for comparison with the feature extracted from the original currency,if more than eight features are matched then display result as real currency otherwise display fake currency.***

IndexTerms - Keywords-Counterfeit currency, image processing, feature extraction, template matching, Latent picture.

I. INTRODUCTION

Many times RBI faces problem of counterfeit currency that major consequences on Indian economy so also increases additional problem. So adding such a technology or machine which will make human efforts more simpler and efficient. Counterfeit Indian Currency of 100, 500 and 2000 appears to have flooded the system and there is no appropriate method to manage with them for a typical person. Common Person fall prey to this currencies. The value of money is increasing and Rs. 2000 and Rs. 500 is the highest value currency existing till date and maximum fake is done in them. From a couple of years, alongside the first money, Fake Currency is additionally flowing in the general public and unbalancing the social congruity of the general public. So the exchange of currency is likewise done in huge amount. Picture partitioning is mostly utilized for situating objects and edges like line and curve in the picture. More precisely, picture partitioning is the technique of giving a label to every edge in the picture such that pixels with the same name share the main feature. Picture restoration is apart from image enhancement in that making such design of an image which is more pleasure to the observer. Image enhancement method (like contrast stretching or de-blurring by a adjust method) given by "Imaging packages" use no a priori model of the process that manufactures the picture. With picture improvement noise can effectively be removed by sacrificing some resolution, but this method is not applicable for many cases. In a Fluorescence Microscope determination in the z-direction is terrible as it may be. With progression in picture preparing strategy which is valuable for recovering objects. Counterfeit cash is a generation of cash created without giving the state or government permission. Producing or utilizing fake cash is a type of extortion or fraud. As we can see the duplicate currency is nearly as old as itself .Prior to the presentation of paper cash, the most common technique for forging included blending base metals with unadulterated gold or silver. A type of duplicating is the generation of archives by real printers in light of fake guidelines.

Fig.1 Security features of 2000 note

Template matching is a method in digital image processing for identifying little parts of a picture which match a template image. It can be used in creating as a piece of value control, an approach to explore a mobile robot, or as an approach to identify edges in pictures. Here mainly 10 feature are extracted from original image and that feature are matched with another input image which is given to the template matching algorithm. Template matching is a procedure, which find the area where ideal matching is acquired by coordinating with a template picture called large scale picture.

Most broadly utilized six format coordinating calculations [8] were utilized and tested as talked about beneath. (x, y) is the inquiry square pixel position and (x', y') is the full scale square pixel positions. T is the full scale square and I is the search square. w and h are the width and height of the picture.

$$R_{sqdiff}(x,y) = \sum_{x'y'} \left(T(x',y') - I(x+x',y+y')\right)^2 \quad (1)$$

$$R_{Norsqdiff}(x,y) = \frac{\sum_{x'y'}[T(x'y') - I(x+x',y+y')]^2}{\sqrt{\sum_{x'y'} T(x',y')^2 \ \sum_{x'y'} I(x+x',y+y')^2}} \quad (2)$$

Technique 1: Squared distinction and Normalized squared Contrast coordinating technique given in equations (1) and (2) individually coordinate the squared distinction. In this way, a perfect match will give a value of zero and a bad match will give a bigger value.

$$R_{Crosscorr}(x,y) = \sum_{x'y'}(T(x',y').I(x+x',y+y')) \quad (3)$$

$$R_{Norcrosscorr}(x,y) = \frac{\sum_{x'y'}(T(x'y') - I(x+x',y+y'))}{\sqrt{\sum_{x'y'} T(x',y')^2 \ \sum_{x'y'} I(x+x',y+y')^2}} \quad (4)$$

Technique 2: In given equation (3) and (4) separately specify the cross correlation & Normalized cross relationship Matching Technique with multiplicatively coordinates layout against an picture producing a ideal match with a bigger value and a bad match with a little value or a zero.

$$R_{crosscoef}(x,y) = \sum_{x'y'}(T'(x',y').I'(x+x',y+y')) \quad (5)$$

$$R_{Norcrosscoef}(x,y) = \frac{\sum_{x'y'}(T(x'y') - I(x+x',y+y'))}{\sqrt{\sum_{x'y'} T'(x',y')^2 \ \sum_{x'y'} I'(x+x',y+y')^2}} \quad (6)$$

Where $T'(x', y') = T(x', y') - \frac{1}{wh}\sum_{(x'y')} T(x',y') \quad and$

$$I'(x+x',y+y') = I(x+x'y+y') - \frac{1}{wh}\sum_{(x'y')} I(x+x'y+y')$$

Technique 3: As we can see conditions (5) and (6) that gives two coordinating like techniques connection coefficient and normalized coefficient That separately coordinate a template when picture perfectly matche will provide value 1 otherwise -1.A value of 0 simply means that there is no relation between template and picture.
So we can see that Above six techniques were tested in dynamic backgrounds and still background separately.

II. LITERATURE SURVEY

As we know the Printing house being able to make fake paper currency but it is workable for any individual to print fake cash simply utilized for laser printer at home. Fake currency detection methods are explain is as below

In [1] the main feature of the paper currency recognition system is the recognition phase of the image. For considering particular signs of paper cash symmetrical mask are preferred. With the assistance of this paper cash acknowledgment framework the expansion of non-masked pixel values in every money is handled and urged to neural system. The overall recognition accuracy of the system is computed as 91.5%. It focuses on the image area with both Prewitt Method and Canny Method masks to distinguish between the different denominations. As the number of features considered is high, processing time is large because symmetric masks need to be generated for each feature and each denomination.

In [3] the system takes advantage of recognition of the material of paper currency, a blend of cotton and paper, to determine authenticity. The polarization features of cellulose are utilized for finding polarized light from the note and test if the concentration of polarized light is same with the output expected from the step of cellulose in currency. Along with detecting the fluorescent sections under UV light, the system achieves adequate results which may be used in conjunction with other systems, but not independently.

Gauri sanjay tele [4] an approach for determination of fraud currency in this extracts the general feature like latent images and identification mark from the picture of currency. Extracting feature from picture of currency notes can get quite difficult as it involves the extraction of some seen and unseen characteristics of Indian note. After demonetization 500 and 2000 are the high valued currency notes existing till date so there is a most extreme likelihood that this notes can be copied all together to avoid this we are using software to detect the fake notes using image processing method.

When more number of feature are extracted from comparison then high success rate is achieved, including those only see under conditions such as backlight or UV light. This technique starts by calculation of a bunch of reference values for each feature of the banknote. For input all required conditions are necessary and converted to a form that is conducive to analysis. On comparison of reference values and input values by shape recognition, hue analysis, pixel intensity comparison, object detection etc., a likelihood algorithm is used to determine its denomination and subsequently verify its validity [5]

Determination of paper currency with the help of digital picture processing method is given in detail . For these three element of Indian paper money is taken for counterfeit cash recognition included recognizable proof stamp, security string and watermark. With the help of feature extraction is applied on the picture of the currency and it is compared with the feature of the real currency. The sobel operator with gradient magnitude utilized for feature extraction. Paper money identification with good precision and high processing speed has important for banking system. As the proposed system gives the simplicity speed so it will be beneficial for recognition of fake currency. The experimental results display that this approach is effective and efficient and clearly meet the system requirements [2]

In [6] the authors introduce LBP (Linear Binary Pattern) as a texture calculating method. This LBP utilized for the texture calculating and characteristics extraction of Indian note. In LBP, the adjacent layout are converted to binary code 0 or 1 by utilizing middle pixel as a threshold of the grey value. Then, all these codes form an ordered pattern according to their relative position to the centre pixel. With good quality images as the input, the accuracy of this system reaches 90%.Although speed and accuracy of the LBP algorithm is high, so it fails decide which is counterfeit notes and which one is genuine. The system which having the low noise level for this LBP technique is useful, thus making determination of fraud notes difficult.

III. PROPOSED SYSTEM

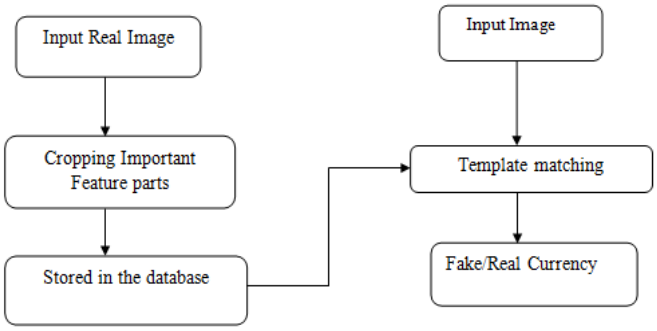


Fig.2 Block diagram of fake currency detection using template matching

A] Input Image:

Here image will be taken by the camera. The acquired picture consists of all the features

B] Cropping important feature

These features are extracted from the original image. The Security Feature of real currency are as follows:

1] ***See through register***: We can see the numeral 2000 through enlist on one side it is empty and opposite side of note it is filled up. It is written horizontally just along the small scale lettering and above the latent picture on the left hand of the money note. When we see the cash against light it is set of single plan

2] **Seven angular bleed lines:** Seven angular bleed lines in 5 bunch of 1-2-1-2-1 are situated on the upper left hand and right hand of the currency and this feature is useful for visually impaired person.

3] Latent image: The latent picture is for security that is settled inside money. When we held currency horizontally that is at 90 angle then we can see the latent image of 2000 numeral. The back side of Rs.2000 currency note occurs with a horizontal band towards the bottom left of the currency note and focuses on a latent image featuring the denominational value in numeral.

4] Identification mark: This Identification marks are especially useful for visually impaired people with this feature they can identify the real or fake. We can see the numeral 2000 on right hand of the watermark window in Indian currency. The sign in this category is a square shape arranged over the Ashoka Pillar Emblem on the correct hand and square shape around the numeral 2000.

5] Micro lettering: This micro lettering refers that it can be read only below the microscope and also under magnifier.. On the Indian currency note of denomination value 2000 are designed as "RBI 2000 INDIA". We can see "RBI2000INDIA" word are written simultaneously on the left hand of the paper currency.

6] Omron feature: Omron feature refers to the circle-shaped anti-copy characteristics situated on the left hand of the currency just above the latent picture.

7] Optically Variable Ink*:* The section value 2000 in the Mahatma Gandhi watermark window of the 2000 cash note is printed on the front side utilizing optically factor ink. The numerals change its color by viewing cash with different edges.

8] Security Thread: The security thread having the width of 3mm in 2000 currency and mainly 6 windowed and this security thread changing its color from green to blue when the note is held at an angle and tilled vertically. And also three words printed on the currency as "RBI", "BHARAT" and "2000".

9] New Numbering Pattern: The numbers in both the number boards tends to increases from left to right yet in this the initial three alpha numeric characters stays stable in shape.

The extracted features are now obtained that are stored for further process

C] ***Template matching****:*

Another input is given to the template matching coding so in this the image obtained from the camera is in a RGB scale so need to convert that RGB scale into Gray image because that Gray scale image contain all the intensity information that is necessary for further process. Then decide one correlation map between two features that is should be greater than 0.9.If this condition is satisfied then only system gives output as currency is real otherwise gives output as currency is fake.

IV. RESULTS

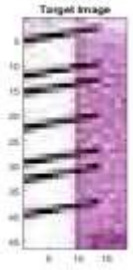
The results of the proposed method are described below:

Take input image then crop important feature of templates. Then stored features in database. Now take another input test currency image. Find correlation between features stored in database and the another input test currency image. If correlation between both greater than 0.9 then features are matched. Then likewise checking for other template. If features are matched then currency is real otherwise currency is fake 9.

Fig (a) shows original image of the currency

(a)

Fig (b) shows seven angular feature cropped from original image.

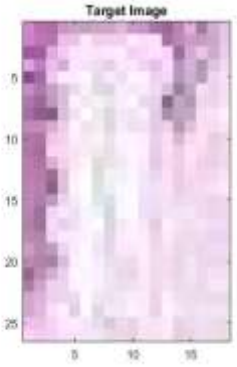


(b)

Fig(c) shows seven angular feature matched with the feature of original currency

(c)

Fig (d) shows when we see through register then numeral 2000 will be see .This is cropped feature of that.



(d)

Fig (e) shows that feature matched with the original image.

(e)

Fig (f) is target image/cropped feature of latent image. When note tilled at 90 degree this feature will be seen

(f)

This latent image feature matched with the real currency as shown in fig. (g)

(g)

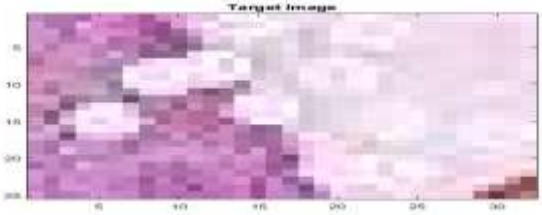
Fig (h) shows the target image of numeral 2000

(h)

Fig (i) shows cropped feature of numeral 2000 matched with original currency.

(i)

Fig (j) shows Omron feature of 2000 currency



(j)

Fig (k) shows Omron feature matched with original currency.

(k)

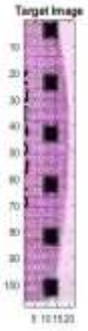
Fig (l) shows Mahatma Gandhi portrait.

(l)

The cropped feature of Mahatma Gandhi portrait matched with original currency in fig. (m)

(m)

For 2000 currency width of security thread is 3mm as shown in fig (n)

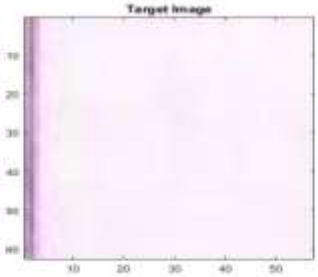


(n)

As shown in fig. (o) Target image of security thread matched with original currency of 2000.

(o)

Fig (p) shows the Mahatma Gandhi watermark



(p)

Fig (q) shows Mahatma Gandhi watermark matched with original currency

(q)

Fig.3 Results of proposed system

From the results of the proposed system it is observed that ,when the second image features are matched with the input image the features then take decision as currency is real otherwise currency is fake. The correlation map between two currency should be greater than 0. 9.

V. CONCLUSION

Here, Template matching algorithm utilized for denomination of counterfeit money . This is low cost system. Here mainly 10 features are extracted from original image and that feature are matched with another input image which is given to the template matching algorithm. This system work for note denomination of 500,2000 for Indian currency. The system also provide accurate and valid results. It is also provide for real time application. The process of detection of fake note will be quick and easy. In this system input will be taken by CCD camera and output will be displayed on PC.

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