Counterfeit Currency Detection Based on Fluorescence in HSV Color Space

D. Stalin Alex, P. Subramanian, S. Subashini, T. Kumaresan, B. Stalin

Abstract: Fake currency notes are so perfect nowadays that it is very tough to differentiate them from original currency notes. Due to technological advancements, it has become very easy for counterfeiter's to imitate all the characteristics of the original currency except the illumination or glow that occurs when the currency notes are induced to UV radiation. The proposed approach is based on this selective feature of color illumination which can be identified when the captured image is converted into HSV color space. Histogram equalization is done in HSV color space which collectively performs noise reduction, filtering and sharpening to enhance image quality for effective use in applications. The original currency will have high intensity color values compared to the fake currency that can be verified by using the thresholding technique. Thus, the proposed method is very simple, efficient and time saving.

Index Terms: HSV (Hue, Saturation and value), color space, histogram equalization, threshold, fake Currency.

I. INTRODUCTION

Improvisation of the economic system is very important in producing the financial growth and giving social agreement. Automatic dispensers fit for perceiving currency notes are broadly utilized in numerous automatic banking operations. The need for automatic currency recognition system has been increased in order to develop a simple and reliable technique. Speed and accuracy are the two major factors to be considered in currency recognition [1]. The currency recognition mainly focuses to express the seeable and concealed marks on paper currency for proficient categorization. Until now, there are numerous strategies proposed for paper currency identification. The straightforward method for fake currency detection is by using the size and features of the currency. However, this technique has impediments as currency notes are getting worn and torn with the progression of time [5]. During circulation, the currency notes have chances of losing information or even damaged. Moreover the complex design in currency notes makes automatic currency identification not easy to process. So it is very essential to know how the characteristics are extracted from the currency image using efficient algorithms to enhance the accuracy of fake currency detection. The proposed strategy is basic and proficient to meet the fast prerequisites in functional applications [2, 7]. Digital image processing is a section characterized by the requirement for in depth experimental planned solutions to the given problem. Image processing has become very useful in research and industrial applications. In Digital image processing the input is an image and the output maybe an image or the attributes extracted from the image. The proposed method in this paper deals with the analysis of the color feature currency notes [3]. The process of extracting the color from folding money could be a difficult task in image process. The algorithmic rule we tend to apply here is incredibly straightforward and works with efficiency. The currency image can be acquired by using a camera or a scanner so that the color feature of currency can be processed [4]. Now the captured image can be processed by applying the techniques like image pre-processing, HSV color space, histogram equalization and color thresholding [11].

II. METHODOLOGY

The Indian currency notes have a special feature called ultraviolet bright fluorescence. Embedded fluorescent filaments into the paper, or written ultra-violet ink onto the paper, makes a type of optical illumination or glow which makes confirmation easy. By presenting the note to ultra-violet light, the ink or strands fluoresce, exhibits a colored pattern which isn't visible under natural light. In the proposed system, the above specific feature of color illumination can be identified by converting the captured currency image into HSV (Hue, Saturation and Value) color space. Color histogram equalization is done in the HSV color space in order to get an enhanced and rich image for extracting the color information of the image very clearly. Finally, thresholding technique is used for extracting and comparing the color intensity of the given currency image with the color intensity of the original currency. Therefore, the fake currency can be easily detected automatically without the need of existing UV detectors. Hence, the proposed system enables automatic detection of fake currency.

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Dr.D.Stalin Alex, Professor, Dept. of IT, Guru Nanak Institute of Technology, Hyderabad, Telangana, India. (Corresponding author E-mail: drstalinalex@gmail.com)

Dr.P.Subramanian, Professor, Dept. of CSE, Sri Indu College of Engineering and Technology, Hyderabad, Telangana, India.

Dr. S.Subashini, Professor, Dept. of CSE, Sethu Institute of Technology, Madurai, Tamilnadu, India.

Dr.T.Kumaresan, Professor, Dept. of CSE, Sri Indu College of Engineering and Technology, Hyderabad, Telangana, India.

Dr.B.Stalin, Assistant Professor, Department of Mechanical Engineering, Anna University, Regional Campus Madurai, Madurai, Tamilnadu, India. (E-mail: stalin1312@gmail.com)

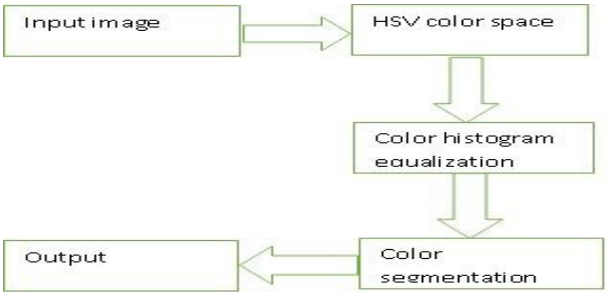

Fig. 1: System architecture

A. HSV Color Pattern

In the projected system, the properties of the HSV (Hue, Saturation and Value) color house of the currency note is analyzed based on the perception of the variation in Hue, Saturation and Intensity values of an currency image element [6]. The pixel values are extracted by selecting the Intensity because the necessary property supported the Saturation value of a pixel. Therefore, a one-dimensional histogram is generated in the HSV space so that a smooth transition of color can be obtained. This enables us to match similar colors of the currency images. The Saturation threshold is used to determine the transition which is usually dependent on the Intensity [8]. Human eye is less sensitive to saturation variation in comparison to variation in Hue or Intensity. Therefore, we have a tendency to use the Saturation values to work out whether or not the Hue or the Intensity has additional vision to human perception of the color of that constituent. Thus, HSV color house makes an approximation within the color of every picture element within the kind of thresholding.

B. Histogram Equalization

For histogram generation, in HSV color area every picture element contributes either its Hue or its Intensity value. The color histogram generated here, retains the color features of the currency notes without loss of information values of Hue varies between 0 to 2π, the end points being red. Thus, the feature is a combination of two independent vectors. The color histograms generated for the currency image will have high values. This is because two colors that appear similar to human eye can have a small difference in their shade [9]. The two histograms are compared using smoothing windows, so, that the color feature of the currency image is retained. The Hue-Intensity boundary of the image can be determined by using the above technique. Thus, by using HSV color space, the results generated have a better performance compared RGB color space.

C. Color Segmentation & Thresholding

Color segmentation is used to disintegrate an image into useful parts for analyzing and representing the currency image in terms of higher-level pixels by separating background and foreground objects [10]. The HSV color area is conspicuously used because it will separate the intensity (luminance) from the color. For every picture element, either its hue or the intensity may be used as dominant feature supported its saturation. Finally, a local thresholding method is applied to each pixel in the segmented currency image and the threshold T is obtained. Now, T is compared with the original currency threshold and if the value of T is less than the expected threshold, the currency is fake.

III. Results and Discussion

Original Currency can be acquired by any device like cam scanner, scanner or capturing images by the camera. Figure 2 shows the original image captured by normal mobile camera. Acquired image should not be in the binary or grayscale image, it should be in the color scale image. The binary or grayscale image gives the false result.

Fig. 2: Scanned image of original currency

Acquired color image converts into HSV- fluorescence images for further processing. Figure 3 shows the HSE-Fluorescence view of original currency.

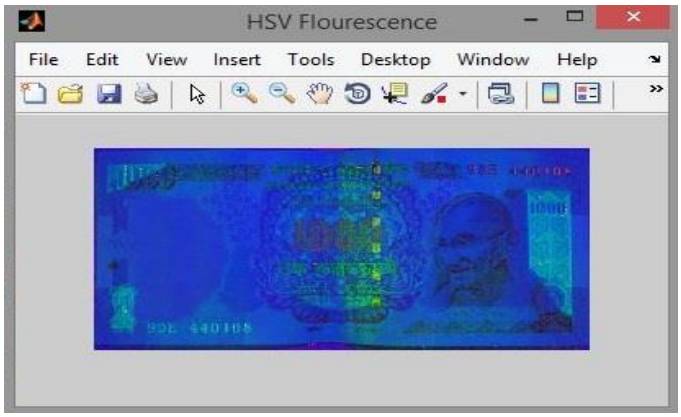

Fig. 3: HSV fluorescence view of original currency

Fake Currency acquired by any acquisition device, Figure 4 shows the fake currency's original view.

Fig. 4: Fake currency

Now, the acquired fake currency converts into HSV-Fluorescence view. Figure 5 shows the fluorescence of fake currency.

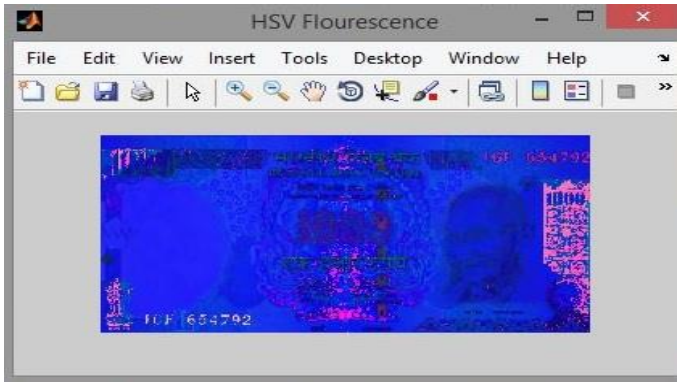

Fig. 5: HSV Fluorescence view of fake currency

IV. CONCLUSION

We have proposed a simple and accurate technique which adopts the HSV color model and thresholding technique. The system uses the interactive techniques such as histogram equalization and color thresholding in order to extract the color of the currency notes and detect fake currency. This technique can be equipped efficiently in automatic dispensers or cash deposit machines for counterfeit detection of Indian paper currency.

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AUTHORS PROFILE

Dr.D.Stalin Alex, Professor and Head of Department of Information Technology, Guru Nanakk Institute of Technology, Hyderabad, India. He received his PhD in Image Processing from Anna University, Chennai, India. He is a member of ISTE. He has published 9 papers in SCOPUS Indexed journals. He filed a patent in the area of Image Processing. Area of Interest: Image Processing, Video Processing.

Dr. P. Subramanian working as a Professor of CSE department in Sri Indu College of Engineering and Technology, Hyderabad. He did his Ph.D in St.Peter's University, Chennai. He has more than 15 years of experience. His area of interest includes wireless networks, Data mining and Image processing.

Dr.S.Subashini, Professor, SIT,Madurai, India. She received her PhD in Data Mining from Anna University,

Chennai, India. She is a member of ISTE. She has published many papers in reputed journals. Area of Interest: Data Mining, Image Mining.

Dr. T. Kumaresan working as a Professor of CSE department in Sri Indu College of Engineering and Technology, Hyderabad. He has completed his Ph. D in Anna University Chennai. He has more than 11 years of experience. His areas of interest includes data mining, image processing, wireless networks and cloud computing.

Dr.B.Stalin received B.E. Degree in Mechanical Engineering from the University of Madras, Tamilnadu, India and M.E. Degree in Manufacturing Engineering from the Anna University, Tamilnadu, India. He obtained his Ph.D. in Mechanical Engineering discipline at Anna University, Chennai, Tamilnadu, India. His current research interests include Materials Characterization, Mechanical Properties, Composite Materials, Optimization Techniques, and Manufacturing Engineering.