ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

The Indian Banknote Recognition Using Speeded Up Robust Features (SURF)

Mayur Jayram More

Technical Lead in MNC & Student of ME, GHRIET, Wagholi, Savitribai Phule Pune University, Pune, India

ABSTRACT: We develop an automated banknote recognition system which can be very good utility for the fields like Banking operations and other fields of commerce. Our banknote recognition system is robust and effective with the following features: 1) high accuracy, 2) robustness, 3) high efficiency, and 4) ease of use. To make the system robust to avariety of conditions including image of any angle, whether it is rotated or not, doesn't mater of its background and whether it is worn or wrinkled bills, we propose a component-basedframework by using Speeded Up Robust Features (SURF).We also have employed the spatial relationship of matchedSURF features to detect if there is a bill in the camera view. Thisprocess largely alleviates false recognition and can guide the userto correctly aim at the bill to be recognized. The evaluation of the proposed system (robustness andgeneralizability) on a datasetincluding both positive images (with Indian banknotes) andnegative images (no Indian banknotes) collected under a variety ofconditions. Though in India, automatic banknote recognition is not common, this system is used in many countries. The recognition system takes scanned images of banknotes for recognition. Experimental results are presented which show that this scheme can recognize currently available 10 notes (1, 2, 5, 10, 20, 50, 100, 500, 1000 & 2000) successfully.The proposed algorithm, achieves 100% true recognition rate and 0% false recognition rate.

KEYWORDS: banknote recognition, computer vision, image processing, SURF

I. INTRODUCTION

In Bank, if we get number of notes of different denominations, then we have to sort them manually. Same situation occurs many places like shopping mall cash counter, temple donation box or at ATM machine we have manually put the notes of different denomination in different boxes (e.g. 100, 500 & 2000). Today we have Indian currency notes of RS. 1, 2, 5, 10, 20, 50, 100, 500 and 2000.

The recent study in Computer Vision for detection of interest points in a given local image, there are multiple algorithms are available. But for detection of image with minimum errors and stable and robust i.e. strong performance and results,Scale Invariant Feature Transform (SIFT) and Speeded Up Robust Feature (SURF) [2] are used. "The sophisticated designs of local image features make them robust to geometric and photometric variations such as rotation, scaling, viewpoint variation, and illumination change. These properties make them well adapted for detecting objects appearing with different scales and orientations in images." [1]

In this paper, I have proposed a system for recognition of banknote, with the help of features of SURF algorithm. SURF algorithm provides us high accuracy in currency recognition. We have referred the same system diagram which is proposed by Faiz M. Hasanuzzaman, Xiaodong Yang, and YingLi Tian. [1] It is as shown in Fig. 1. In proposed system, we take image of currency form any input (file system, camera of mobile/laptop, etc). Further we apply SURD descriptor on it. Then we will match these features with stored classes. This will provide us matching features of threshold. With the help of this result we can recognize whether the provided image of currency is of recognized currency or not.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

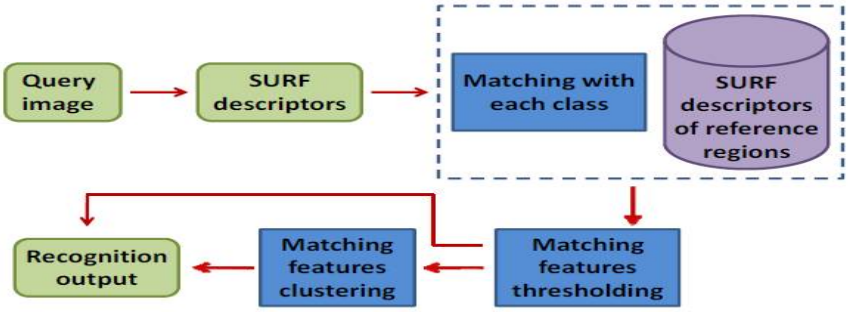

Fig. 1: System diagram of the proposed banknote recognition [1]

Fig. 2: Note Teller 2 - Talking Money Identifier [3]

II. RELATED WORK

In last some years, there is much research and development happened on this topic to recognize the paper currency for different purpose [5-14] like to help blind or visually impaired people, etc. Some of them have used Artificial Neural Network technique to get the result. Thesetechniques take image of currency from camera, process the image and gives result on the screen in printed format or in audio format.

Fig 2 shows a talking money identifier product in a market "Note Teller 2", developed by BRYTECH [3]. This is portable machine that can fits in your pocket. This is mainly useful for Blind, Visually Impaired and Deaf-Blind People in US.

Similarly there are many more applications available in market for coins and bank notes to recognize currency of different country and for different audience.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

III. PROPOSED ALGORITHM

A. COMPONENT-BASED FRAMEWORK FOR BANKNOTE RECOGNITION

In our system we first have collected images of all bank notes of front and back side. Fig 3 shows the reference banknotes of RS 1, RS 2, RS 5, RS 10, RS 20, RS 50, RS 100, RS 500, RS 1000, RS 2000 of Indian currency. In our system, a total of 22 images of ten categories of bills (1, 2, 5, 10, 20, 50, 100, 500, 1000 and 2000) with front and back sides are taken as ground truth images. For each component, SURF features are extracted and saved for later matching with the query images in the recognition process.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

Fig 3: Reference currency banknotes of Rs 1, 2, 5, 10, 20, 50, 100, 500, 1000 and 2000

B. LOCAL IMAGE FEATURE DETECTION AND REPRESENTATION

In our application the requirement is to detect the currency image in a given input image. The input image may have currency image in any corner, it may be overlapped with some other object, it may be in any angle and it may be folded or wrinkled. There are many conditions that we could get image. It is also possible that input image may don't have any banknote in it. The SURF algorithm has all these properties to fulfill our requirement and it gives faster results.

B1. Interest Points Detection and Description

Detection and Description points are computationally effective by SURF algorithm. SURF has based on different modules for good performance like Hessian Metrix, box filters, Gaussian derivatives, etc.

B2. SURF Evaluation on Banknotes

We have taken images of all 10 types of banknotes in different conditions to test the result of application. We also have added negative images which don't have any banknote. Our aim in this practice is to test performance of application and the result is as shown in Table 1.

Value	No. of Images	False Recognition Rate	True Recognition Rate
1	10	0	100%
2	10	0	100%
5	10	0	100%
10	10	0	100%
20	10	0	100%
50	10	0	100%
100	10	0	100%
500	10	0	100%
1000	10	0	100%
2000	10	0	100%

Table 1: Banknote recognition result

C. ALGORITHM

We have stored the Banknote images (DB_Images) to check input image(I).
We will check input image with each stored image.

Calculate KeyPoints of input image I_{in}
For each stored Image I_s
    Calculate the KeyPoints of I_s
    Match the KeyPoints of both Images
    If (both are same)
        Return true;
    Else

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

Continue;

IV. BANKNOTE SYSTEM DEVELOPMENT AND RESULTS

The system which will be running on mobile devices or on Computer or laptops. The system will always have three parts like Input Section, Middle layer to compute result and output cancel which will be printed on screen and/or speaker for audible result.

The following Fig shows some result of applications.

Fig 4 : The result of application where input image is contain folded banknote of rs 10 on right side which is taken from internet and saved on hard disk and we have stored image on left side.

Fig 5 : The result of application where input image of rs 100 on right side which is taken from camera and we have stored image on left side.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 4, Issue 12, December 2016

V. CONCLUSION AND FUTURE WORK

In this paper, we have proposed a system to recognise banknote using SURF. It provides true result with 100% accuracy and 0% negative result.
In future we will try to cover the coin recognition part also and will try to cover banknotes of different countries.

REFERENCES

1. Faiz M. Hasanuzzaman, Xiaodong Yang and YingLi Tian, "Robust and Effective Component-based Banknote Recognition for the Blind", IEEE Transactions on Systems, Man, and Cybernetics--Part C: Applications and Reviews.
2. H. Bay, T. Tuytellars, and L. Gool, "SURF: Speeded Up RobustFeatures", European Conferecne on Computer Vision, 2006.
3. http://www.dati.org/loan/pictures/big/014-002-206-00_bg.jpg
4. Note Teller 2, http://www.brytech.com/
5. D. Dakopoulos and N.G. Bourbakis, Wearable Obstacle Avoidance Electronic Travel Aids for Blind: A Survey, IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews, Volume: 40 , Issue: 1, 2010 ,
6. N. Giudice and G. Legge, Blind navigation and the role of technology, in The engineering handbook of smart technology for aging, disability, and independence, A.A. Helal, M. Mokhtari, and B. Abdulrazak, Editors. 2008, Wiley: Hoboken, N.J.
7. R. Manduchi, J. Coughlan, and V. Ivanchenko, Search Strategies of Visually Impaired Persons using a Camera Phone Wayfinding System, 11th International Conference on Computers Helping People with Special Needs (ICCHP '08). 2008.
8. R. Manduchi, S, Kurniawan, and H. Bagherinia, Blind Guidance Using Mobile Computer Vision: A Usability Study. ACM SIGACCESS Conference on Computers and Accessibility (ASSETS), 2010.
9. H. Shen, K. Chan, J. Coughlan, and J. Brabyn, A mobile phone system to find crosswalks for visually impaired pedestrians, Technology and Disability, Vol. 20, 2008.
10. H. Shen and J. Coughlan. "Grouping Using Factor Graphs: an Approach for Finding Text with a Camera Phone." Workshop on Graph-based Representations in Pattern Recognition. 2007.
11. E. Tekin, J. Coughlan and H. Shen. "Real-Time Detection and Reading of LED/LCD Displays for Visually Impaired Persons." 2011 IEEE Workshop on Applications of Computer Vision (WACV 2011), 2011.
12. Y. Tian, X. Yang, and A. Arditi, Computer Vision-Based Door Detection for Accessibility of Unfamiliar Environments to Blind Persons, 12th International Conference on Computers Helping People with Special Needs (ICCHP), 2010.
13. X. Yang, Y. Tian, C. Yi, and A. Arditi, Context-based Indoor Object Detection as an Aid to Blind Persons Accessing Unfamiliar Environments, International Conference on ACM Multimedia, 2010.
14. N. Aim and J. Arnott. Computer-Assisted Conversation for Nonvocal People Using Prestored Texts. IEEE Trans. Systems, Many, and Cybernetics, Part C: Applications and Reviews, vol. 28, no. 3, 1998.

BIOGRAPHY

Mayur Jayram More, is a student of Master of Computer Science, G H Raisoni, Institude of Engineering and Technology, Savitribai Phule Pune University. He has done his BE in Computer Science from NMU, Jalgaon, MS, India.