Evaluation of the sailent features in Indian currency notes

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Abstract

Security features are topographies invisible to the naked eye, such as micro-printing or features visible in ultraviolet, transmitted, and oblique light. The present paper focuses on the examination of Indian currency notes such as 2000, 500, 200, 100, 50, 20, and 10 in different light sources and with the help of a compound microscope. This kind of examination is very useful when it comes to distinguishing counterfeit currency from genuine one. Crime is increasing day by day, and so is the making of false currency – this study discusses the numerous security or hidden features which are invisible to the naked eye, and therefore may very well be missed by the potential perpetrator. It is the responsibility of the government along with the issuing authority to incorporate these structures

into all travel and security documents, including passports, voter-id cards, and many others. These features are implemented either during the manufacturing of the paper itself (e.g., fluorescent fibres) or at the time of printing (e.g., microprinting, watermarks, and other fluorescent features).

Keywords: currency notes, micro-printing, fluorescence, transmitted light, counterfeit currency.

Introduction

Advancements in banking facilities and automated systems are very important for various devices using automated systems to recognize banknotes, such as computerized ATMs, vending machines, or ticket dispensers. These systems usually apply rapid processing and accuracy recognition – innovations in this field serve to protect the economy from counterfeit currency and maintain social order. The need for such automatic tools encouraged many researchers to develop corresponding robust and reliable technology which facilitates the false currency identification process. Counterfeit products are often used to disguise something in order to abuse the general reputation of the original – counterfeit money looks like the genuine currency, but is issued without proper government approval, and therefore is not safe for the country.[1]

The present paper focuses on noteworthy elements of Indian currency notes, created for security reasons as well as to make it easier even for a layperson to distinguish ordinary banknotes from counterfeit ones. A big step towards verifying undeclared dark cash in India was taken on

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[1] T. Pathrabe, S. Karmore, "A novel approach of embedded system for Indian paper currency recognition", *International Journal of Computer Trends and Technology* 1, 2011, no. 2; M. Tanaka et al., "Recognition of paper currencies by hybrid neural network", [in:] *IEEE International Joint Conference on Neural Networks Proceedings. IEEE World Congress on Computational Intelligence, 4–9 May 1998, Anchorage, AK*, vol. 3, Piscataway, NJ 1998; N. Jahangir, A.R. Chowdhury, "Bangladeshi banknote recognition by neural network with axis symmetrical masks", [in:] *Proceedings of the 10th International Conference on Computer and Information Technology, 27–29 December 2007, United International University, Dhaka-Bangladesh*, Dhaka 2007; R. Mirza, V. Nanda, "Paper currency verification system based on characteristic extraction using image processing", *International Journal of Engineering and Advanced Technology* 1, 2012, no. 3; R. Mirza, V. Nanda, "Characteristic extraction parameters for genuine paper currency verification based on image processing", *IFRSA International Journal of Computing* 2, 2012, no. 2.

8 November 2016 – with demonetization taking place, the government started the production of new currency notes which incorporated new security features. 2000 and 500 were the very first banknotes launched and also the most commonly used. Usually, counterfeit currencies carry the general watermark of the father of the nation and a fluorescent line of RBI – so features which can be easily incorporated.[2]

Objectives

The present study aims to examine the hidden features present in currency notes and provide tools for distinguishing genuine banknotes from counterfeit ones.

Material and methodology

The currency notes of the following denominations were collected: 2000, 500, 200, 100, 50, 20, and 10.

Instrumentation used: various light sources and a compound microscope.

Light sources used: visible, ultra-violet, and transmitted.[3]

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[2] B.K. Sharma, "Counterfeiting of Indian currency", *CBI Bulletin* 2000, no. 11; J. Oliver, J. Chen, "Use of signature analysis to discriminate digital printing technologies", [in:] *18th International Conference on Digital Printing Technologies 2002 (NIP 18), 29 September – 4 October 2002, San Diego, CA*, Springfield, VA 2002; S.C. Mittal, N. Arora, "Forgery of rupees five hundred denomination notes: Methods of detection", *CBI Bulletin* 2003, no. 2; K. Suneet et al., "Forensic analysis of security features in Indian currency denomination of ₹500 authentication and recognition through Docucenter NIRVIS instrument", *Journal of Forensic Sciences and Criminal Investigation* 13, 2020, no. 3, art. 555865.

[3] Ultraviolet light is electromagnetic radiation with a wavelength 10 nm to 400 nm smaller than that of visible light, but greater than that of X-rays. Transmitted light examination is the process in which the light is conceded through the surface and is not reflected. Micro-printing refers to the production of a recognizable pattern which is only visible under certain magnification, invisible to the naked eye – it is one of the most effective ways to hide security features. A. Pal, H.K. Pratihari, "Spectral studies on original and fake rupees 1000 denomination note", *International Journal of Chemistry and Applications* 4, 2012, no. 2.

Procedure

1. The denomination should be crease free in order to visualize the features appropriately. Place the note under a visible light source to examine the general features of the currency from both sides.

2. Once the visible light features are examined, place the note in a UV light source and note down the fluorescent features on both sides.

3. Conduct the transmitted light examination – it usually concerns watermarks present in various places.

4. Analyse the micro-printing using a compound microscope to allocate the features present in different places with variable magnification, such as 4×, 10×, 40×, etc.

5. Make sure not to mark anything on the currency because it can hinder the process of analysis.

Observations

Figure 1. General currency features in visible light examination

1. The size of the note is 63 mm × 129 mm and the overall color is green-yellow.

Table 1. The dimensions and colors of the banknotes

Denomination	Dimensions	Color
2000	66 mm × 166 mm	magenta
500	66 mm × 150 mm	stone grey
200	66 mm × 146 mm	bright yellow
100	73 mm × 157 mm	blue green
50	66 mm × 135 mm	fluorescent blue
20	63 mm × 129 mm	green-yellow
10	63 mm × 123 mm	chocolate brown

2. Guarantee clause, promise clause along with the governer's signature and the stamp of the RBI (Reserve Bank of India).

3. Intaglio printing of the numeral 20 in green ink.

4. Intaglio printing of the protrait of Mahatma Gandhi (additionally, there are bleed lines present in the corners of the 100, 200, 500, and 2000 banknotes).

5. See-through register is the denomination of the banknote.

6. Ashoka emblem in intaglio printing.

7. Numeral 20 in Devnagiri.

8. Number panel (by size, in ascending order).

9. Year of printing.

10. Sawach Bharat Abhyan logo and slogan.

11. Language panel.

12. The motif of historical monuments – in this case, the Ellora Caves. The 2000 banknote contains the motif of Mangalyan, 500 – the Red Fort, 200 – Sanchi Stupa, 100 – Rani ki Vav, 50 – Hampi, and 10 – the Konark Sun Temple.

Different types of security features in UV, transmitted, and microscopic examination

Denomination: 2000

UV examination: various bands, fibers, and the security thread give fluorescence.

Figure 2
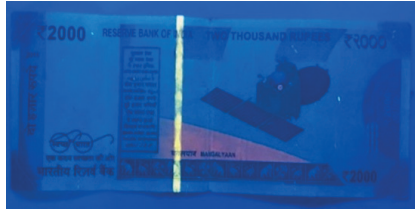
Figure 3

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 2000. On the extreme left, numeral 2000, RBI, various dark and light bands, symbol 2K on the bottom left.

Figure 4

Micro-printing examination: visualized at 4× magnification.

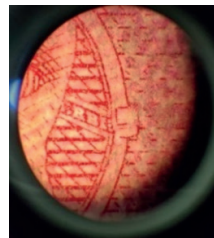Figure 5. "RBI2000INDIA" above the see-through register

Figure 6. "RBI" on the spectacles of Mahatma Gandhi
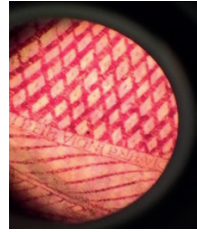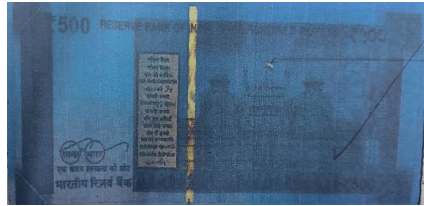
Figure 7. "Bharat"
on the security wire

Figure 8. "Bharat, INDIA"
on Mahatma Gandhi's collar

Denomination: 500

UV examination: various bands, fibers, and the security thread give fluorescence.

Figure 9

Figure 10

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 500. On the extreme left, numeral 500, RBI, various dark and light bands.

Figure 11

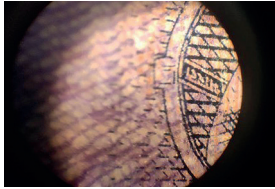**Micro-printing examination:** visualized at 4× magnification.

Figure 12. "Bharat, INDIA" on
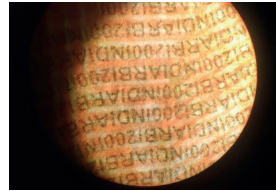Mahatma Gandhi's collar

Figure 13. "RBI500INDIA"
above the see-through register
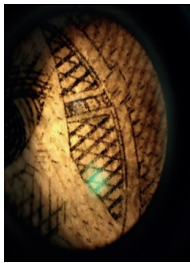
Figure 14. "RBI" on the spec-
tacles of Mahatma Gandhi
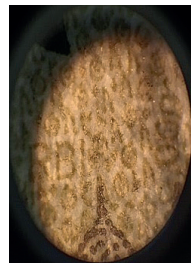
Figure 15. "RBI" near
the flag on Red Fort

Denomination: 200

UV examination: various bands, fibers, and the security thread give fluorescence.

Figure 16

Figure 17

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 200. On the extreme left, numeral 200, RBI, various dark and light bands.

Figure 18

Micro-printing examination: visualized at 4× magnification.

Figure 19. "Bharat" on Mahatma Gandhi's spectacles

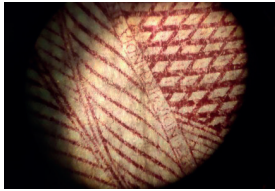Figure 20. "RBI200INDIA" above the see-through register
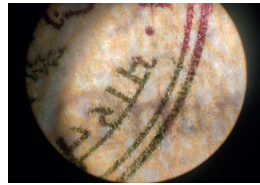

Figure 21. "Bharat, INDIA" on Mahatma Gandhi's collar

Figure 22. Color change from dark maroon to green in the Ashoka emblem

Denomination: 100

UV examination: bands do not give prominent fluorescence whereas fibers and the security thread do.
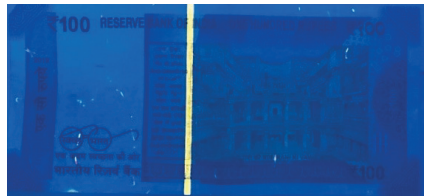

Figure 23

Figure 24

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 100. On extreme left, numeral 100, RBI, various dark and light bands.

Figure 25

Micro-printing examination: visualized at 4× magnification.

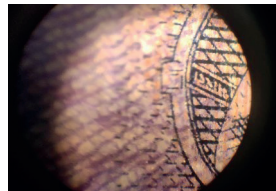Figure 26. "RBI100INDIA" above the see-through register

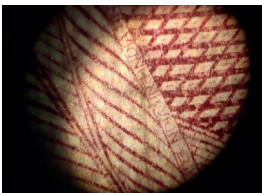Figure 27. "Bharat" on Mahatma Gandhi's spectacles
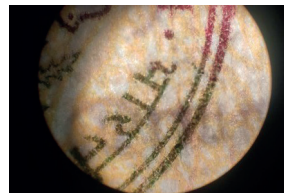

Figure 28. "Bharat, INDIA" on Mahatma Gandhi's collar

Figure 29. Color change from dark maroon to green in the Ashoka emblem

Denomination: 50

UV examination: bands do not give prominent fluorescence whereas fibers and the security thread do.
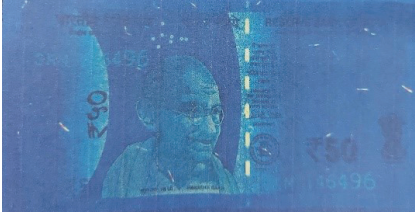
Figure 30

Figure 31

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 50. On the extreme left, numeral 50, RBI, various dark and light bands.

Figure 32

Micro-printing examination: visualized at 4× magnification.

Figure 33. "B" on the spectacles of Mahatma Gandhi

Figure 34. "RBI 50" above see-through register

Figure 35. "Bharat, INDIA"
on Mahatma Gandhi's collar

Figure 36. "50" on Mahatma
Gandhi's right ear

Denomination: 20

UV examination: fibers, the security thread, and numeral 20 present on the bottom left give prominent fluorescence.
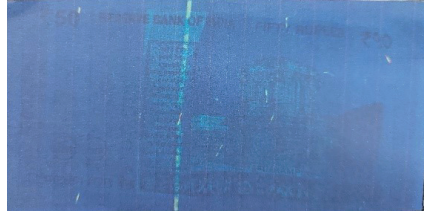

Figure 37

Figure 38

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 20. On the extreme left, numeral 20, RBI, various dark and light bands.

Figure 39

Micro-printing examination: visualized at 4× magnification.

Figure 40. "Bharat" on the spectacles of Mahatma Gandhi

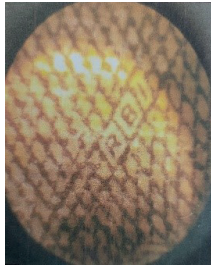Figure 41. "20" on the right ear of Mahatma Gandhi

Figure 42. "RBI" on Mahatma Gandhi's collar
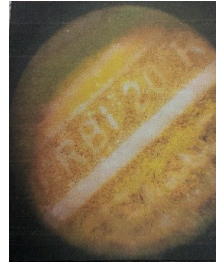

Figure 43. "RBI 20" above the see-through register

Denomination value: 10

UV examination: fibers, the security thread, and numeral 20 present on the bottom left give prominent fluorescence.

Figure 44

Figure 45

Transmitted light examination: watermark with the portrait of Mahatma Gandhi along with numeral 10. On the extreme left, numeral 10, RBI, various dark and light bands.

Figure 46

Micro-printing examination: visualized at 4× magnification.

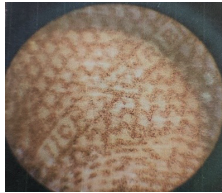Figure 47. "Bharat" on spectacles of Mahatma Gandhi

Figure 48. "RBI 10" above the see-through register

Figure 49. "Bharat, INDIA" on right side corner of the currency

Conclusion

During our research, we were able to find and present security features incorporated into Indian currency which are visible in UV and transmitted light as well as through a compound microscope. Our chief aim was to make people aware of such elements and ways in which they can distinguish genuine banknotes from fake ones. Security features include: latent images, watermarks, fluorescent dyes, and micro-printing built into the currency by the government to avoid the negative impact forged currency could have on the economy and the development of the country. These features are maintained throughout the process of printing and are changed every 10 to 20 years. However, incorporating them into the cur-

rency is a costly process, therefore their number varies depending on the specific denominations. At best, approximately 3 different microprinting elements are present in the lowest-value banknotes – 10. Watermarks are always manufactured at the same spot in all the currency, whereas the position of microprinting varies. India is a developing country, hence the focus is always on results and cost efficiency. Consequently, in the future, we will surely be dealing with some of the methods used to counterfeit currency and should have the means to detect them.

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