

Spectral Analysis of New Indian Currency of Denomination ₹500 using VSC-5000

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Abstract:Counterfeiting of currencies is a major issue and therefore, incorporation of security features in bank notes poses to be a crucial aspect. In this regard, every nation tends to embed unique security features in order to prevent duplication of national currency. Currency notes in India are issued by the Reserve Bank of India and has certain security features that are subjected to enhancement at certain interval of time. However, India has encountered demonetisation on 8th November 2016 after Government of India (GOI) announced the ban on prevalent bank notes of denomination ₹ 500 and ₹ 1000. The announcement also stated the launch of new banknotes of denomination of ₹ 500 and ₹ 2000 with new security features. The present paper focuses on studying the details of the security and printing features of the new paper currency of ₹500 in Video Spectral Comparator-5000 under various wavelength light sources.

Keywords:Counterfeiting, Currency Note, Security Features, Printing Features

1- INTRODUCTION

Government of a nation issues currency in the form of paper notes as well as coins, which are circulated in the economy to be used in the form of exchange medium for availing goods and services ⁽¹⁾. In India, the issuance of the currency is under the control of the Reserve Bank of India ⁽²⁾. India has faced major problems in relation to circulation of fake Indian currencies. In the year, 2012, the Finance Minister of India, Mr. P. Chidambaram had declared in the Parliament that there is no availability of confirmed estimate regarding fake currency in India ^(3,4). In order to combat the issue, both Central and State Governments have been working in tandem, which has led to the formation of the Fake Indian Currency Notes

Coordination Centre (FCORD) by the Ministry of Home Affairs for periodic reviewing of the matter⁽⁵⁾.

1.1 Legal Ramifications in relation to Counterfeiting of Currencies

Section 28 of Indian Penal Code describes “counterfeiting” while the punishment for the mentioned offence is stated in **Section 489 (A), (B), (C) and (E)** mentioning imprisonment for 10 years along with charging of fine. It is deemed as a “Non-Bailable, Cognizable Offence” and triable by Court of Session. Unlawful Activities Prevention Act (UAPA) 2008 revised from amendment of 1967 is considered for registering cases involving use of counterfeit currencies in conducting terrorist activities⁽⁶⁾.

1.2 Events leading to Demonetisation in India

In the year 2012, a shipping consignment from Pakistan to Nepal via Hong Kong and China was seized for having concealed counterfeited Indian currency notes. According to FATF Report of June, 2013, it has been stated that India is suffering from the issue of counterfeit currencies not only at the national level but also internationally. On the basis of the evidence available with the Indian Law Enforcement Agencies (LEAs), there is a clear indication regarding printing of counterfeited Indian notes in Pakistan and the transit points have been identified through the way of Dhaka, Bangladesh, Sri Lanka, UAE and Bangkok. Moreover, India-Pakistan border and India-Nepal border poses to be transit points for smuggling counterfeited currencies^(7,8).

Smuggled counterfeited currencies were deemed to be a source of monetary facilitation for terrorist activities. In order to combat the issue of counterfeiting and thereby mitigate it, Indian Prime Minister, Shri Narendra Modi declared the demonetisation of Indian currency notes of denomination ₹ 500 and ₹ 1000 on 8 November 2016 along with the introduction of new bank notes of denomination ₹ 500 and ₹ 2000⁽⁹⁻¹⁵⁾.

2. METHODOLOGY

Video Spectral Comparator (model 5000) and Stereomicroscope have been used for studying the different significant features introduced in the new currency note of ₹500. These newly introduced features has been examined under different range of light in combination with

various filters available in VSC- 5000. The available currency notes of ₹ 500, first examined under the visible light followed by examination under the UV light for studying the characteristic security features and printings by completely non-destructive techniques.

3. RESULTS and DISCUSSIONS

The results found in the spectral study of Indian paper currency note of denomination ₹ 500 have been presented below. Following type of security features on paper currency note were analysed under Video Spectral Comparator-5000.

3.1. Colour and Size

The ₹500 currency note having dimensions 66 mm X 150mm has stone grey as the base colour and is outlined by white space. The multicolour printing styles that have been introduced in ₹500 are difficult to be accomplished using photocopier as it is achieved by repeated level of complex printing process. The colours include stone grey in combination with light brownish and light greenish hues.



5:24 PM 1/5/2017 Lights=Flood 100%, Longpass=VIS, Bandpass=OFF, Mag=2.077
 Auto Exposure (Integration=1/15, Iris=50%, Gain=0dB), Brightness=Auto, Contrast=Auto, Imaged width =177.18 mm

Figure 1: The frontal view of newly Introduced Indian Currency note of ₹500



5:28 PM 1/5/2017 Lights=Flood 100%, Longpass=VIS, Bandpass=OFF, Mag=2.077
 Integration=1/22, Iris=50%, Gain=0dB, Brightness=Auto, Contrast=Auto, Imaged width =177.18 mm

Figure 2: The back side view of newly Introduced Indian Currency note of ₹ 500

3.2. Introduction of symbol of Indian Currency “₹”, Slogan of “स्वच्छभारत” and “Red Fort” along with Tricolour “तिरंगा”

The symbol of “₹” introduced first time after its approval as a symbol of Indian Currency on 15th July 2010. It is visible about 4 times in front as well as four (04) times on the backside. The symbol ‘₹’ is also introduced in microprintings and latent image. The back side of currency note is covered by the Red Fort as well as the tagline of Central Government’s nation-wide campaign “Clean India Mission” i.e. “स्वच्छभारत”.



5:24 PM 1/5/2017 Lights=Flood 100%, Longpass=VIS, Bandpass=OFF, Mag=2.077
 Auto Exposure (Integration=1/15, Iris=50%, Gain=0dB), Brightness=Auto, Contrast=Auto, Imaged width =177.18 mm

Figure 3: The location of ‘₹’ symbol in front side of newly Introduced Indian Currency note

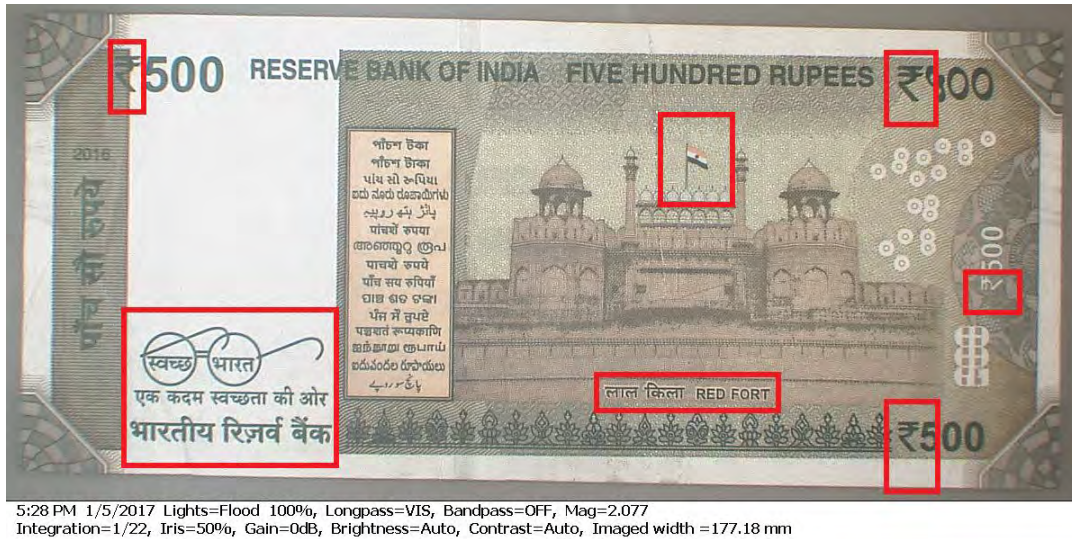


Figure 4: The location of ‘₹’ symbol along with “Tricolour”, “Red Fort” and “Swachh-Bharat” in back side of newly Introduced Indian Currency note

3.3. Complicated portraits

The portrait of Mahatma Gandhi has complicated set of strokes that is difficult to replicate without specialised equipment. Moreover, in comparison to other geometric aspects, replication of a human face is considered to be the most difficult feature.



Figure 5: The portrait of Mahatma Gandhi introduced in ₹ 500 currency.

3.4. Watermark

The portrait of Mahatma Gandhi has been used as watermark, which poses to be the most popular kind of security feature of Indian currency notes. It has been introduced in the note during the printing process by means of dandy roll. Watermark of portraits are deemed to be more reliable in terms of security as it contains more semi-shadows.



Figure 6: The visible watermarks in transmitted light at various places in ₹ 500 currency

3.5. Security thread

The paper of the note has a thin ribbon that is woven into the fibre of the paper and has text engraved in it. It appears to be woven in and out of the paper, however, when held against the light it appears to be a solid line. The security thread has the feature of colour shift that changes from green to blue when subjected to tilting. It has “RBI” and “भारत” written alternatively.



Figure 7: Paper currency note of ₹ 500 showing green colour security thread in visible light

3.6. Fluorescence and Optical Security fibres

The number panels of the banknotes are printed in fluorescent ink. The banknotes also have dual coloured optical fibres. Both the aforementioned features can be seen when the banknotes are exposed to ultra-violet lamp.

The coloured viscous fibres are randomly mixed during the manufacturing of cotton pulp and visible under UV Light. In ₹ 500 currency notes, three coloured optical fibres i.e. yellow, blue and green are seen under the UV Light in both sides.



5:26 PM 1/5/2017 Lights=365nm Ultra Violet, Longpass=VIS, Bandpass=OFF, Mag=2.077
 Integration=1.4 Sec, Iris=73%, Gain=12dB, Brightness=50, Contrast=30, Imaged width =177.18 mm

Figure 8: Paper currency note of ₹ 500, optical fibres giving fluorescence under 365nm Ultra Violet (Front side view).



5:30 PM 1/5/2017 Lights=365nm Ultra Violet, Longpass=VIS, Bandpass=OFF, Mag=2.077
 Integration=2 Sec, Iris=50%, Gain=12dB, Brightness=50, Contrast=30, Imaged width =177.18 mm

Figure 9: Paper currency note of ₹ 500, optical fibres giving fluorescence under 365nm Ultra Violet (Back side view).

3.7. See Through Register

On the left side of the currency note next to the watermark window, half the numeral of each denomination is printed on the front and the other half on the back. The accurate back to back registration makes the numeral appear as one when viewed against light.



Figure 10: Paper currency note of ₹500 showing see through register denomination number 500 in transmitted light (both side comparable image).

3.8. Latent Image

In the banknotes of ₹ 500, the latent image of ₹ 500 is on left side of Mahatma Gandhi's portrait on front side while it is present thrice on the back side of the currency note. The images are readable when the banknote is held horizontally and light falls on it at 45°; otherwise this feature appears only as a vertical band.

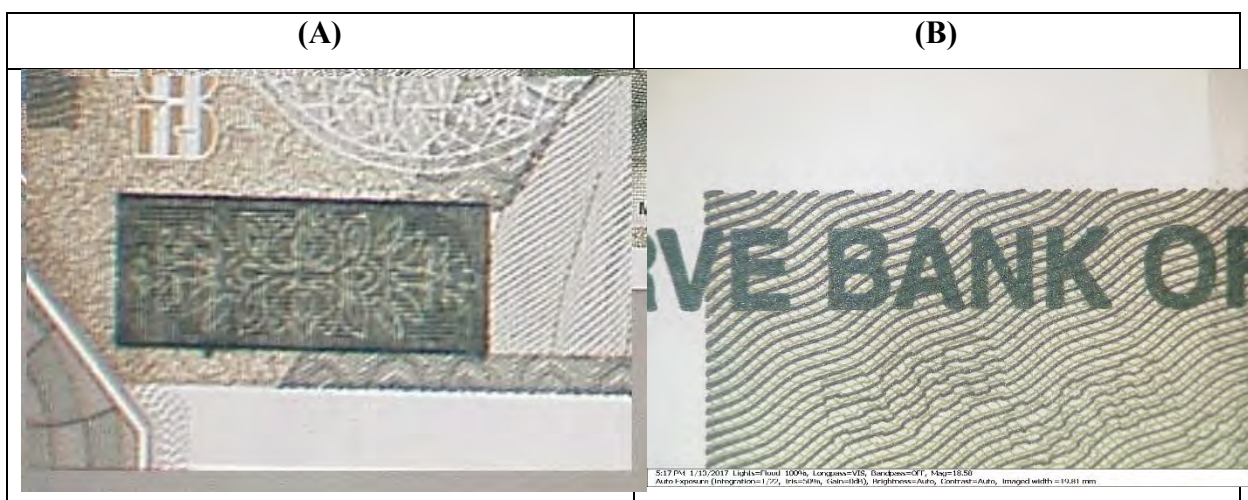


Figure 11: Paper currency note of ₹ 500, shows latent images in; (A) ₹ 500 in front side and (B) three times 500 in backside.

3.9. Marks for Blind

Special line marks for blind people are also incorporated in the currency note. It is in both left and right side in face side is available. Five lines; two pair of parallel and one divider line is printed by intaglio printing in ₹ 500 currency note. This mark is for understanding the currency for blind persons as it is different in ₹ 2000 currency note as well as in new ₹ 200 & ₹ 100 currency notes.

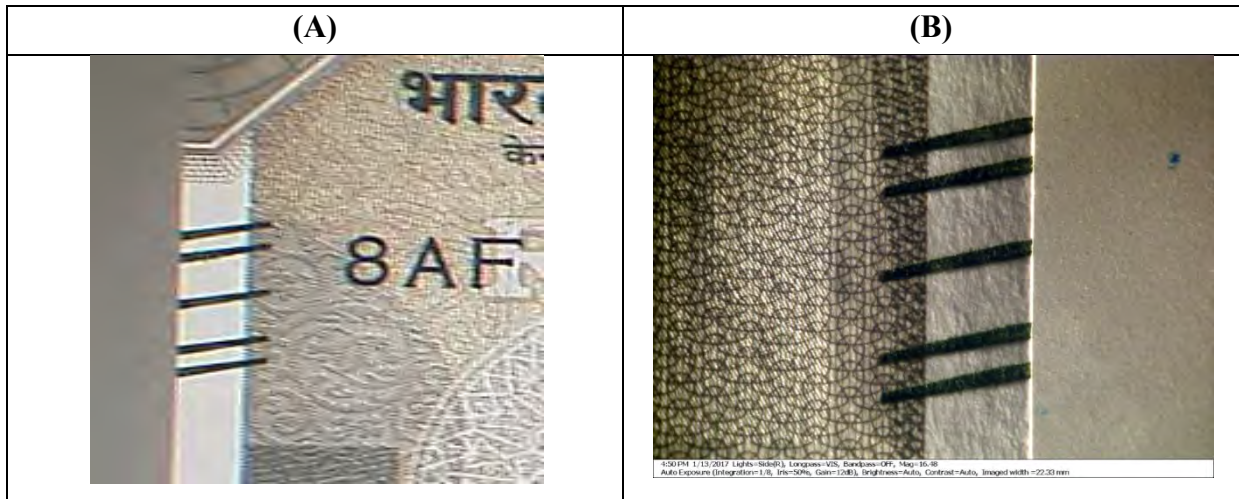
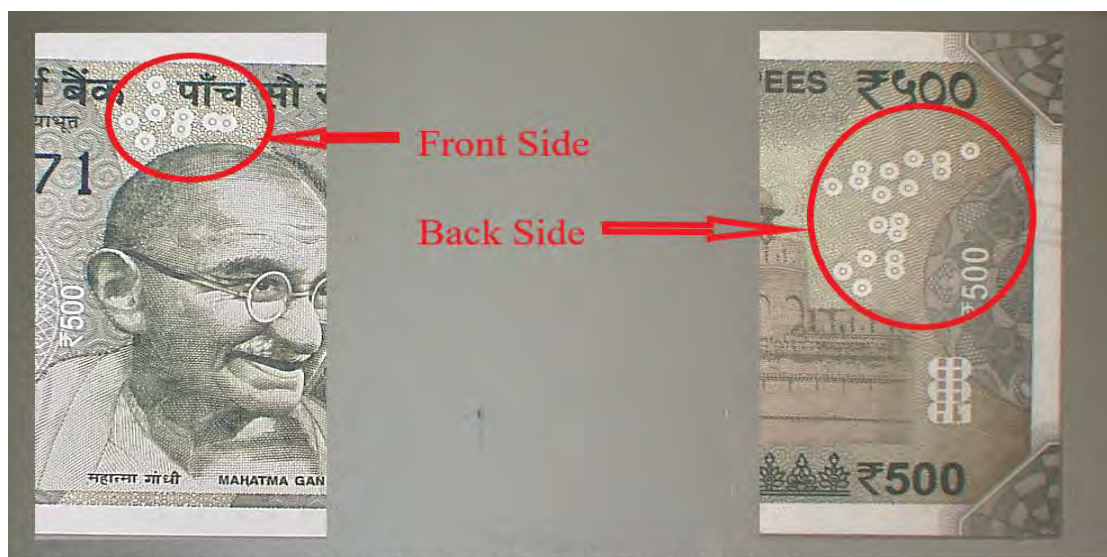


Figure 12: Paper currency note of ₹ 500, blind marks is (A) Left side and (B) right side.

3.10. Anti-copy features

This feature has been introduced on both side i.e. front as well as back side for prevention of the copying of genuine currency notes. As Omron feature is introduced two times so it is difficult to copy this feature and it provides more stability in the genuineness of currency note.



5:28 PM 1/5/2017 Lights=Flood 100%, Longpass=VIS, Bandpass=OFF, Mag=2.077
 Integration=1/22, Iris=50%, Gain=0dB, Brightness=Auto, Contrast=Auto, Imaged width=177.19 mm

Figure 13: Paper currency note of ₹ 500, Omron features in both front and back side.

3.11. Optically Variable Ink (OVI)

Optically Variable Ink i.e. Colour –shifting ink is introduced in ₹ 500 Currency note for printing ₹ 500 by intaglio printing. Intaglio printed ₹ 500 on the lower right side of currency note appears green when the banknotes are held flat but would change to blue when the banknotes are held at an angle.



Figure 14: Paper currency note ₹ 500 showing OVI (optical variable ink) printing of ₹ 500. The ₹ 500 appear Green when note is held flat and turns Blue when the angle of the note is changed or it is tilted.

3.12. Identification mark

A special feature in intaglio has been introduced on the right side above the Ashok Emblem on ₹ 500 currency note. This feature is in different shapes for various denominations i.e. Circle in ₹ 500, H-shape in ₹ 200, Rectangle in ₹ 2000 with the symbol of “₹ ” and denomination of currency.



Figure 15: Paper currency note of ₹ 500, Identification mark Circle in ₹ 500.

3.13. Micro Printings

Micro printings are an essential and very important part of any currency note for establishing its genuineness. Newly introduced currency note of ₹ 500 have a unique microprinting base. Micro printing is introduced on many places in ₹ 500 currency note in order to ensure its genuineness. These microletters is printed by either Off-set printing or Intaglio printing. Microprints contain letters ₹ 500, RBI, Bharat, India on various places on both front and back side.

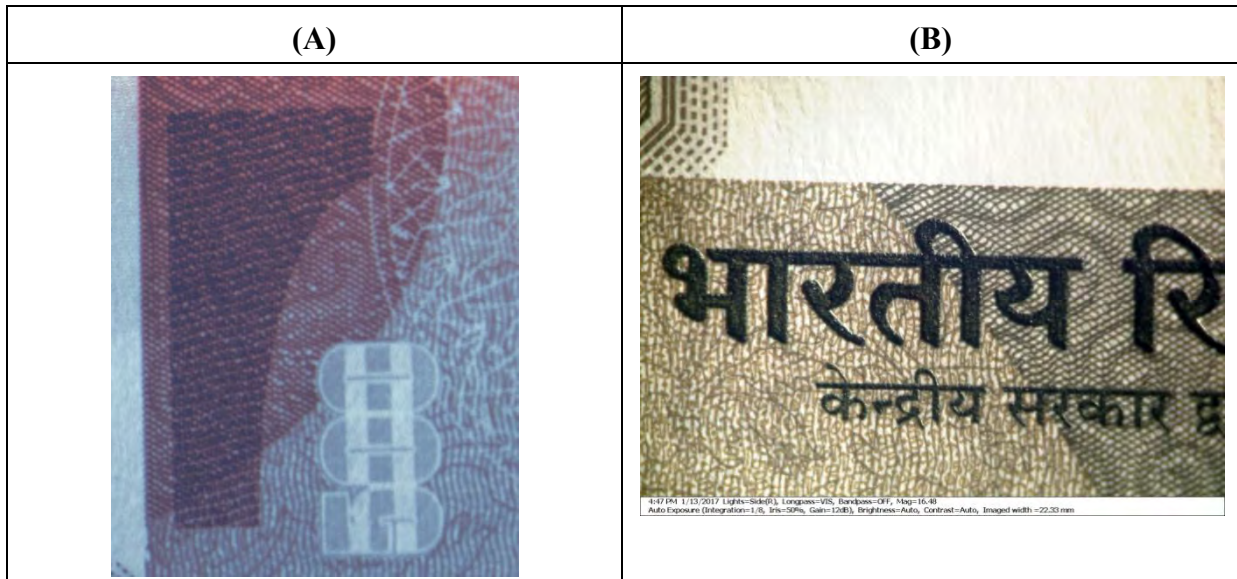


Figure 16: Paper currency note of ₹ 500 showing position of micro-printing at various places

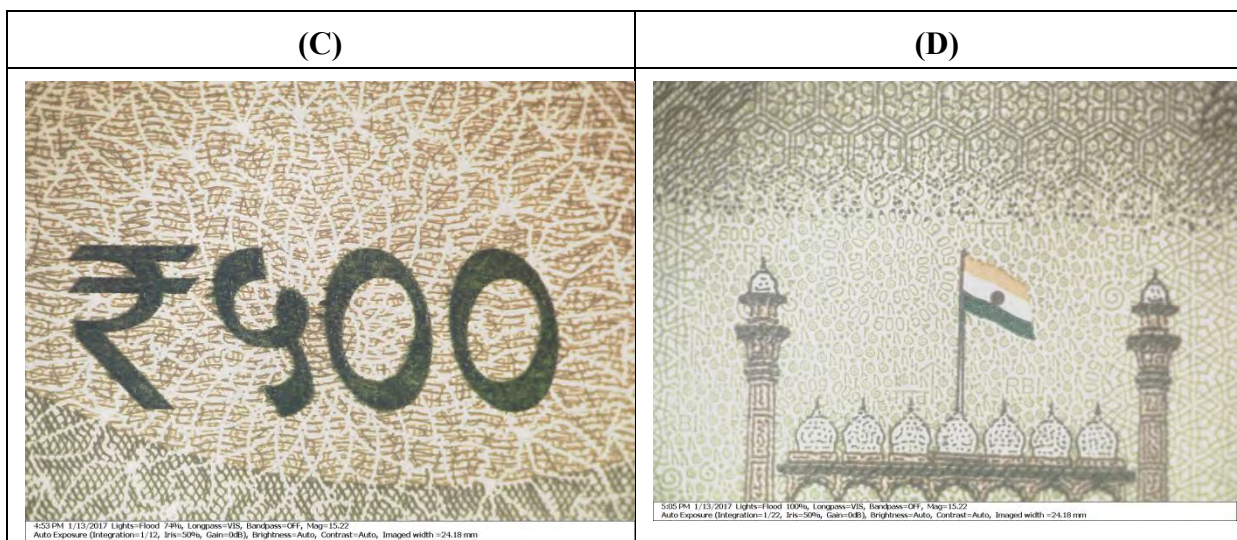


Figure 17: Paper currency note of ₹ 500 showing position of micro-printing at various places

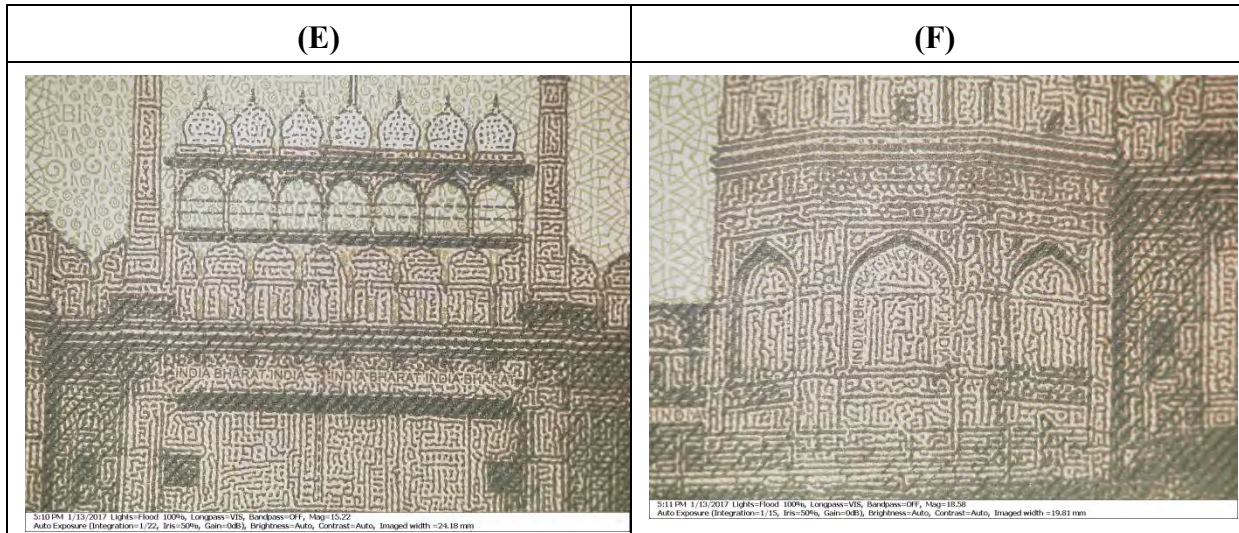


Figure 18: Paper currency note of ₹ 500 showing position of micro-printing at various places

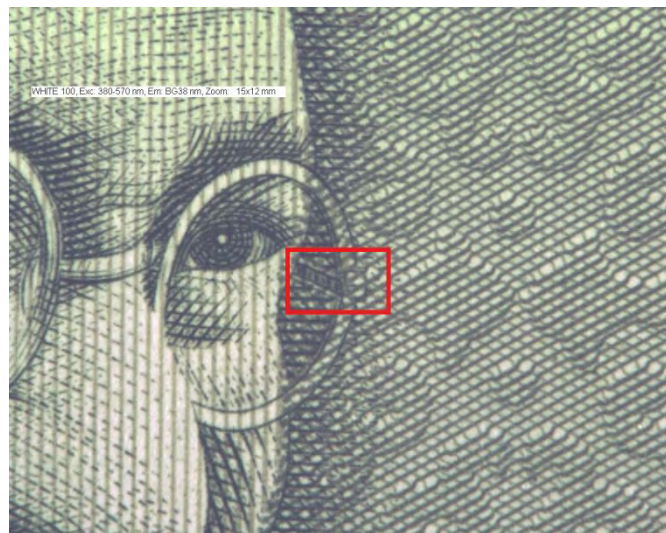


Figure 19: Paper currency note of ₹ 500 showing position of micro-printing “RBI” on glass stand of portraits of Mahatma Gandhi

3.14 Printings Introduced

The new currency note is printed with high level of precaution for preventing its duplication. Off-set printing, Intaglio printing and Letter-press printing has been introduced as a printing process and make of currency note.

A- Off-Set printing

This printing process is introduced in the formation of background of the currency note. The different colours with a very standard ink is introduced in the printing of currency. The offset based Microprinting is used for the printing of microtexts.



Figure 17: Paper currency note of ₹ 500, Background is printed by Offset printing process.

B- Intaglio Printing

Intaglio printing is introduced over the off-set printing for the writing. The make of Ashok Emblem, seal of Reserve Bank of India as well as Promise clause is written by Intaglio Printing. In the front side of currency note, most of the writing portions are printed by Intaglio printing except microprintings.



Figure 18: Paper currency note of ₹ 500, Reserve Bank of India seal, ₹ 500 is printed by Intaglio printing.

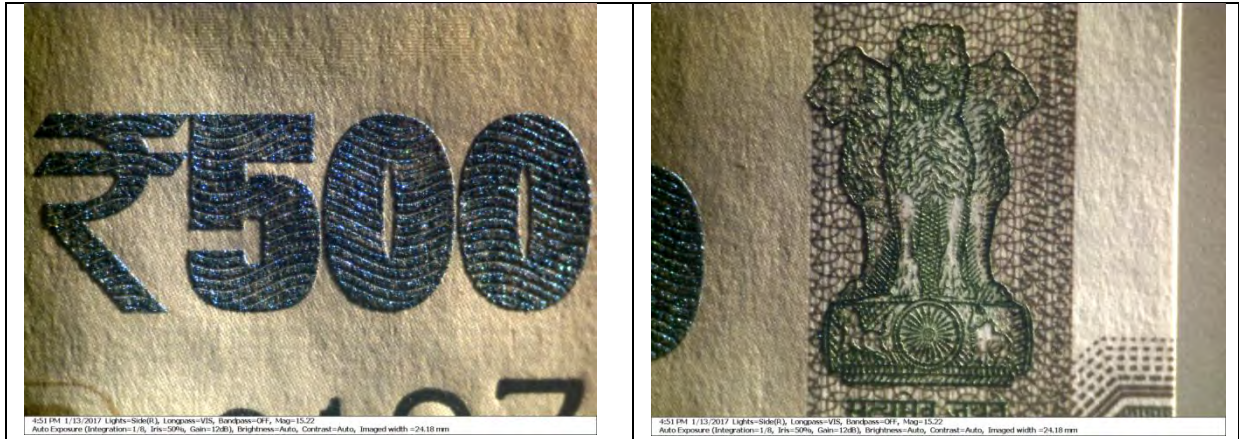


Figure 19: Paper currency note of ₹ 500, Ashok Emblem is printed by Intaglio printing



Figure 20: Paper currency note of ₹ 500, Promise clause and other writings is printed by Intaglio printing

C- Letter Press Printing

Letter press printing is introduced for the numbering of currency note. The number panel has the numbers and number size is printed in ascending order and is imprinted by using letter press printing method.



Figure 21: Paper currency note of ₹ 500, currency number is printed by Letter press printing.

4. CONCLUSION

It can be concluded that the new Indian currency note for ₹ 500 has unique security and printing features that demonstrates the potential of distinguishing original currency from counterfeited ones. The currency has printed by using Off-set based Intaglio and Letter Press printing process. The presented security features are shown only for the education and understanding purpose, a part of these features many other security features also introduced. The present currency note of ₹ 500 is more secure in compare to old currency note i.e. ₹ 500 & ₹ 1000. Hence, the presented features can be adopted by bank officials, money exchangers, security agencies and forensic investigators for understanding the security features of new currency note.

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