To Identify the Security Features of New Indian Currency Notes Under Different Light Sources

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Abstract: **Indian Currency Notes (INR) are forged many a times, but there are so many features present inside the notes itself, which can be detected under different light sources such as visible light, transmitted light, oblique light, Reflected light and ultraviolet light. By examining the different Indian Currency Notes under different light we will be getting different security features in different form in the notes. By using this light technique, we not only examine the security features of INR, also of different currencies of different countries. Here we will be discussing the security features of only INR under different light sources.**

Keywords: **authentic, bleed lines, decimalized, forge, intaglio print, motifs, oblique, Omron features, optical variable ink, resilient, ultraviolet light.**

1. Introduction

The Indian Currency Notes is called the Indian Rupee (INR) and the coins are called Paise. One Rupee consists of 100 Paise. The symbol of the Indian Rupee is '₹' [1].

The design resembles both the Devanagari letter "₹" (ra) and the Latin capital letter "R", with a double horizontal line at the top. The issuance of the currency is managed and controlled by the Reserve Bank of India [2].

2. History of INR

The word 'rupee' has been derived from the Sanskrit word rupyakam, meaning a silver coin. It owes its origin to rupiya, issued by Sher Shah Suri in 1540-45. Today, the Reserve Bank of India issues currency under the RBI Act 1934. ET traces the history of rupee from the British era to now [3].

- 1540-45 - Silver coin issued by Sher Shah Suri. It remained in use during the Mughal period, Maratha era and British India.
- 1770-1832 - Earliest paper rupees issued by Bank of Hindostan (1770– 1832), General. Bank of Bengal and Bihar (1773–75), and Bengal Bank (1784–91).
- 1 Apr 1935 - Reserve Bank of India is set up.
- Jan 1938 - First note of Rs5 issued by the Reserve Bank.
- Feb-Jun 1938 – Rs. 10, Rs. 100, Rs. 1,000 and Rs. 10,000 issued.
- Aug 1940 – Rs 1 note reintroduced. Rs1 was first introduced on 30 Nov 1917, followed by Rs2 and 8 annas, and was discontinued on 1 Jan 1926.
- Mar 1943 – Rs 2 introduced.
- 1950 - First post-Independence coins issued in 1 pice, 1.2, one and two annas, 1.4, 1.2 and Rs 1 denominations.
- 1953 - Hindi was displayed prominently on the new notes, and plural of rupaya 1954 was decided to be rupiye.
- 1954 - High denomination notes of Rs 1,000, Rs 5,000, and Rs 10,000 reintroduced.
- 1957 - Rupee was decimalized and divided into 100 naye paise.
- 1957-67 - Aluminium one-, two-, three-, five- and ten-paise coins introduced.
- 1967 - Sizes of notes reduced due to the lean period of the early Sixties.
- 1980 - New notes issued with symbols of science & tech (Aryabhatta on Rs 2 note), progress (oil rig on Rs 1 and farm mechanization on Rs 5) and Indian art forms on Rs 20 and Rs 10 notes (Konark wheel, peacock).
- Oct 1987 - Rs 500 note introduced due to the growing economy and fall in purchasing power.
- 1988 - Stainless steel coins of 10, 25 and 50 paise introduced.
- 1992 - Rs 1 and Rs 5 coins in stainless steel introduced.
- 1996 -The Mahatma Gandhi series of notes issued, starting with Rs 10 and Rs 500 notes. This series has replaced all notes of the Lion capital series. A changed watermark, windowed security thread, latent image and intaglio features for the visually handicapped were the new features.
- 2005-08 - New 50 paise, Rs 1, Rs 2 and Rs 5 stainless steel coins introduced.

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- 2009 - The printing of Rs 5 notes (which had stopped earlier) resumed.
- July 2010 - New symbol 'Rs' is officially adopted.
- 2011 - 25 paise coin and all paise coins below it demonetized. New series of 50 paise coins and Rs 1, Rs 2, Rs 5 and Rs 10 notes with the new rupee symbol introduced.
- 2012 - New 'Rs' sign is incorporated in notes of the Mahatma Gandhi series in denominations of Rs 10, Rs 20, Rs 50, Rs 100, Rs 500 and Rs 1,000.
- Nov 2016 - Rs 500 and Rs 1,000 notes discontinued and new Rs 500 and Rs 2,000 notes introduced. [4]

3. Manufacturing of INR

The government owned presses at Nasik (Western India) and Dewas (Central India). The other two presses are at Mysore (Southern India) and Salboni (Eastern India). Coins are minted in four mints owned by the Government of India. [5]

The mints are located at Mumbai, Hyderabad, Calcutta and Noida.

The materials used for making the Indian Currency Notes (INR) are:

The INR is made up of pulp containing cotton and balsam with special dyes to make the currency notes that should be resilient, durable, with quality to resist from wear and tear and not to be faked easily.

4. Light Sources

1. Visible Light – Light or visible light refers to the visible region of the electromagnetic spectrum. Its wavelength ranges from 400-700nm. It usually lies between Ultraviolet light and Infrared light. Human beings can only see objects in this range.
2. Transmitted Light – When a light is absorbed or scattered by an object without reflecting the light.
3. Oblique Light – When the light source is placed at a low angle such as 45 degree for showing the details of an object. The light is thrown at a specific angle from a specific place.
4. Reflected Light – When the light bounces back from a smooth surface at the same angle from which the light is striking the surface.
5. Ultraviolet Visible Light – It is a light which comes or originates beyond violet visible light and its wavelength ranges from 100-400nm.

A. Security Features of Indian Currency Notes

1) Security Feature on front side of note
- See through Registrar: A design is present on the left side printed both on front (hollow) lines and back (filled up) of the note.
- Latent Image: A floral design is present on the left bottom of the currency note, in which latent image with denominational numeral seen.
- Denominational numeral is written in the Devnagari language.
- Mahatma Gandhi's portrait present in centre facing

to right.
- Color Shift windowed Security Thread with inscription RBI which made up of Optical Variable Ink.
- Promise Clause with Governor's signature and RBI emblem towards right.
- In blank window electrotype watermark of denominational numeral & Mahatma Gandhi portrait facing to the left.
- Number panel with numeral growing from small to large size, is printed on top left side and bottom right side.
- Denomination numeral with rupee symbol, color changing ink (green to blue).
- The Ashoka Pillar Emblem in intaglio printing on the right side of the note.
- Identification mark: Small identification mark is present in which denomination numeral is written in intaglio printing.
- For visually impaired: Bleed lines are present on both left and right side printed in intaglio form.
- Omron Features: The Omron anti photocopying feature appears in the form of tiny yellow circles.
- Security Threads: These are present in uneven numbers and are embedded inside the note which cannot be copies easily.

2) Security Feature on reverse side of note
- Year of Printing is present on the left side of the note.
- Swachh Bharat logo with slogan at the bottom left of the note.
- The language panel is present towards the centre.
- Also on the reverse side of the note different motifs are present.
- Security Threads are also present on this side of note in uneven numbers.
- These are some of the features present in the currency notes which cannot be easily forged. These features are seen in different ways in different notes when seen in different light sources.

Photographs Showing Security Features of INR under UV Visible Light:

Fig. 1. It is the front side of 500 Rupee note. Under Ultraviolet Light source we can easily see the different security threads present inside the 500 note which are scattered non-uniformly along with all other features as mentioned in table 1
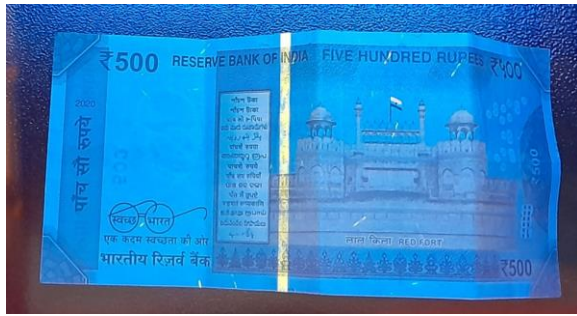
Fig. 2. It is the back side of 500 Rupee note under Ultraviolet light source which is showing different security features as mentioned in table 1

Fig. 3. These are some more photographs of 20 and 100 rupee note, both front and back side to observe security features of Indian Currency Notes under Ultraviolet light source as mentioned in table 1

Table 1
Security features under different Light Sources

Light Source/ Security Features	Indian Currency Note	Visible Light	Transmitted Light	Oblique Light	Reflected Light	Ultraviolet Light
See through registrar	Same in all notes from Rs 10 to Rs 2000	A design is present on the left side printed both on front (hollow) lines and back (filled up) of the note.	The design is more clear under the transmitted light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	This design becomes more clear, colorful and exactly distinguishable under uv light.
Latent Image	Same in all notes from Rs 10 to Rs 2000	Denominational numeral is written in floral design but not seen clearly.	Under this light denominational numeral is seen clearly.	The denominational numeral is seen more clear.	It is seen as it is as under visible light.	It is seen dark black in colour.
Denominational Numeral	Same in all notes from Rs 10 to Rs 2000	It is written in devanagri script and can be seen.	It is seen as it is as under visible light.	The color of denominational numeral changes green to blue.	The color of denominational numeral changes green to blue.	The blue color of denominational numeral is vacant only border is seen.
Mahatma Gandhi's portrait	Same in all notes from Rs 10 to Rs 2000	It is printed in intaglio printing and can easily be determined.	It is seen as it is as under the visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	Intaglio print lines are easily visible and distinguishable under this light source as compared to other sources.
RBI inscripted thread	Same in all notes from Rs 10 to Rs 2000	It is seen in blocks but RBI inscription is not seen under visible light.	It is seen in a single thread and inscripted RBI is also seen clear.	It is seen as it is as under transmitted light.	It is seen as it is as under visible light.	It is seen in blocks and golden in color and RBI inscription is seen clearly.

Promise Clause of RBI	Same in all notes from Rs 10 to Rs 2000	It is written on the right side of the note with governor's signature.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is more darker and clearly seen under uv light.
Watermarked Blank Window	Same in all notes from Rs 10 to Rs 2000	It is seen blank only, no watermark can be seen.	Watermark of Mahatma Gandhi's portrait and denominational numeral is seen clear.	Watermark of Mahatma Gandhi's portrait and denominational numeral is seen clear.	It is seen as it is as under visible light.	Watermark is not seen, only blank space is seen.
Number Panel	Same in all notes from Rs 10 to Rs 2000 but digits are different in all notes and no two notes have same numbers.	It is also seen increasing in size.	It is seen as it is as under visible light. Color changes from blue to green.	It is seen as it is as under visible light. Color changes from blue to green.	It is seen as it is as under visible light. Color changes from blue to green.	It is seen yellowish green in color in increasing size.
Ashoka Pillar Emblem	Same in all notes from Rs 10 to Rs 2000	It is also printed in intaglio printing.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	Intaglio print lines are easily seen.
Identification Mark	Same in all notes from Rs 10 to Rs 2000	denomination numeral is written in intaglio printing.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen more darker and clear.
Bleed Lines	No. of bleed lines present on different note at one end – Rs10 – no lines Rs20 – no lines Rs50 – no lines Rs100 – 4 lines Rs200 – 4 lines and 2 circles Rs500 – 5 lines Rs2000 – 7 lines	For visually impaired person bleed lines are present on the ends of the note.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	The color of bleed lines changes to reddish brown but number of bleed line is seen as it is.
Omron Features	Same in all notes from Rs 10 to Rs 2000	Yellow circles are present on the upper side of the notes and can be seen easily.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	The color of omron features changes to dark blue in which a black dot is present inside it.
Year of Printing	Same in all notes from Rs 10 to Rs 2000	It is also printed on the notes at the back side.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.
Swachh Bharat Logo	Same in all notes from Rs 10 to Rs 2000	It is printed on the back side of the notes.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.
Language Panel	Same in all notes from Rs 10 to Rs 2000	It is printed on the middle of the back side of the panel in 12 different languages.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	On the one end of language panel the security thread is completely seen as a single line.
Motifs	Rs 10 – Konark Sun Temple Rs 20 – Ellora caves Rs 50 – Hampi with chariot Rs 100 – Queen's stepwell Rs 200 – Sanchi Stupa Rs 500 – Red Fort Rs 2000 – Mangalyan	Different motifs of different scriptures are present on the back side of note.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	It is seen as it is as under visible light.	The real and exact more color of that different motifs is seen under this light. The motifs become more colorful under this light as compared to other light sources.
Uneven Security Threads	Same in all notes from Rs 10 to Rs 2000	It is not fixed in numbers but cannot be seen easily in visible light.	It not seen or visible under transmitted light.	It is not seen or visible under oblique light.	It is not seen or visible under reflected light.	Security threads are only seen under the ultra violet light.

5. Conclusion

Under visible light, transmitted light, oblique light and reflected light there are several features which can be easily seen and it is possible for a normal person to distinguish between the normal or real and forged or fake currency notes.

There are so many forgers who can easily forge the security features of Indian Currency Notes which are seen under visible light, transmitted light, oblique light and reflected light. It is possible that a person can easily copy the features in the forged currency.

Usage of ultraviolet light can be a way to detect the security features in different ways but we can get an exact and full proof result. It is not possible for a forger to forge the security threads as it is only seen under the ultra violet light and they are not fix in the numbers as we have observed it under the ultraviolet light. We can easily detect the forged currency from the real currency notes.

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