Review Paper

Morphological and Chemical Analysis of Farzi (Fake) Indian Currency

Niharika DN[1], Rakesh. V[2]

[1]Student, Msc. Forensic Science, Department of Forensic Science, Garden City University, Bangalore,
[2]Asst. Professor, Department of Forensic Science, Garden City University, Bangalore.

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Abstract

In Forensic Science, Morphological and chemical analysis of farzi currencies plays a very important role in identifying the counterfeit currency. The term "counterfeit" refers to fake or forgery which is an exact replica of the original. As there is a rapid advancement in technology there is a drastic increase in crime rate with respect to technology as well where culprits are using advanced and modern technologies for committing crime, here counterfeit currency falls one among them, where culprits are using wellversed technologies in manufacturing fake notes and coins which cannot be easily recognized by the public. In India though RBI is taking a lot of precautions to overcome counterfeiting by implementing high security features in Indian currency such that it cannot be duplicated easily, some or the other way these fake currencies are circulating in the society and people are lacking knowledge in identifying these fake notes and coins.

Some of the security features for identifying these fake currencies is revealed to public by the RBI in its guidelines. Though criminals disguise the original by circulating fake currencies, it is impossible to implement the authenticated security features in it. The composition and its ratio of the original varies from the duplicate which is a loophole, and this can be easily analysed by forensic scientists by keen observations and conducting certain physical and chemical tests. We tried to differentiate between fake and original currencies of India by using RBI guidelines and by performing certain chemical tests through which counterfeit currencies can be analysed.

Key words: Counterfeit currency, Farzi (fake), RBI and its guidelines, Morphological and chemical Analysis, Advanced technologies, Security features.

Introduction

In forensic science, Identification of fake and original currency plays a very crucial rolin preventing certain crimes related to smuggling, crime against nation, white collar crimes and helps in finding the new technologies through which criminals are disguising the original currencies.

Though the criminals disguise the original currency, they can only produce a replica which visually looks alike but they cannot produce the exact copy because original currency is manufactured with a lot of security features in it and some security features are hidden and they cannot be easily visible.

We considered Indian coins and notes for identifying the counterfeit currency and our Indian currency has a lot of security features embedded in it.

Some of the security features of Indian currency are mentioned below:

Corresponding Author: Rakesh. V, Asst. Professor, Department of Forensic Science, Garden City University, Bangalore
E-mail: rakesh.v@gardencity.university

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1. **For Notes:**

According to RBI guidelines notes can be identified by the following aspects:

a) Morphological analysis:

- We can observe the changes in Gandhi's picture on the note i.e., Gandhi's picture will have identical changes in its appearance because one cannot make the exact replica of it.
- Notes have the magnetic strips embedded on it in which Bharat (Hindi), RBI wordings are written on it in an alternative manner throughout the length of the strip. This strip can be identified only by scanning in government provided apps.
- Micro designs on the notes with different pattern of art on it - This cannot be easily replicated because there will be minute spacing in between the design and only RBI has original design with it which is designed by the team of expert artists. If anyone tried to disguise it, it won't be the same because of the minutia characters.
- Watermarks of Gandhi's picture along with the denomination of currency in numbers is without distorted lines for the original note and will be in distorted lines in the fake notes.
- Micro lettering of the words 'Bharat' & 'India' are seen at Gandhi's collar in his picture on the note which cannot be matched even in high resolution scanners. There will belines on Gandhi's picture, these lines are in such away that they are superimposed in a different pattern called "MOIRE'S EFFECT".
- RBI microlettering is seen on the Gandhi's spectacle's frame.
- Ink used for manufacturing these notes is "optically variable ink (OVI)'' also called as "colour shifting ink'' which is fluorescent in nature and is an anti- counterfeiting measure taken by RBI.
- Original notes will be having a clear edge finishing and has a standard measurements and dimensions for each note of varying cost. Notes have a peculiar serial number where these serial numbers are in their increasing order.
- Notes are printed using special type of paper having the composition of cotton fabric along with Lenin and gelatine. These papers are not easily available, the complete details and the purpose of use are recorded, and permission is required to use these papers.
- Standard thickness of notes as per new rule is about 90 GSM (grams per sq. Meter) for 10 - 1000 rupees and having a calliper thickness 110 microns for 10- 1000 rupees.
- Margin and corner designs of notes will be having micro lettering of RBI imprinted on it.

b) Chemicalanalysis:

- Magneticstrips when observed under UV light gives fluorescence.
- Solubility test can be performed (since it is a destructive method this test is notrecommended).
- Burntest can be performed (since it is adestructive method this test is not recommend).

2. **For coins:**

Indian coins are generally made up of metals such as stainless steel, nickel and brass and have a standard composition percentage.

a) Morphologic alanalysis:

- The metals used for coin manufacturing varies from one coin to other having different costs.
- The pattern in which the letters and designs imprinted on a coinisd one by "EMBOSSING'' methods.
- Fonts and letters imprinted on coin will be different for counterfeit coins.
- Spacing between letters and alignment of the letters will be uneven in counterfeit coins.
- Standard Logo of Indian coins has a particular size, shape and embossing pattern which cannot be replicated by others, and we can easily differentiate these things in counterfeit coins.
- There is a standard measurement and thickness for every coin which is given by RBI, this can be identified for counterfeit coins.
- Coin edges will be having lands and grooves

with an equal spacing between them and this cannot be replicated.

- Margin designs are designed in apeculiar way which I simpossible to replicate.

b) Chemicalanalysis:

- Verniercallipers can be used to measure the thickness of the coins.
- Acid-base tests can be performed because the composition and quality of original coins are very high and quite resistant to acid and bases and counterfeit coins will not sustain acid base tests.
- Electric conductivity and resistivity can be checked.

Fig. 1 Showing original 1000 rupees note.
Fig. 2 showing counter feit 1000 rupee note.

Examining a variety of Indian notes and coins helps in identifying the counterfeit currency and helps in understanding the methods used by the culprits to manufacture counterfeit currency to provide much more security and develop much more strong features to secure our currency.

Experimental section

- A total of 5 samples of counterfeit coins were collected and a sample of counterfeit note is collected along with it 7 original notes were collected of rupees 10,20, 50,100,200,500,2000.
- The experiment was carried out, under the following conditions:

  a) A sample of counter feit note of 1000 rupees was compared with the original.

  b) 5 samples of counter feit coins were subjected to acid test.

  c) 7 samples of original notes were subjected to morphological analysis for exploring the security features on them.

1) Comparison of 1000 rupees note: (*from fig. 1 and fig.* 2)

- The analysis was done in naked eyes using magnifier.
- The comparison revealed changes in designs of the margin, the counterfeit note had a completely different design at the margin.
- The Gandhi's picture watermark of the counterfeit note was completely different.
- The counter feit note when touched it felt like aplasticcoatingonitandhada great thickness difference when compared to the original.
- The magnetic strip was embedded in the original note whereas a sticker resembling magnetic strip was pasted on the counterfeit note.
- There were no characteristic features like RBI, India was not visible on the collar of Gandhi in fake note.
- Moire's effect of super imposed line designs was missing in fake note and were present in original.

2) Acid test for counter feit coins:

- The coins were subjected to acid test using conc. HCl.
- The coins which were original did not showed any changes and blackening was less when treated with conc. HCl.
- The coins which were counterfeited were showing black precipitate along with fumes on it with change in colour that is the coin turned black. It may be caused due to change in composition of an individual coin as well.

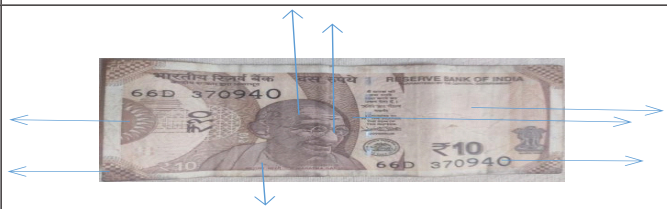
Fig. 3 showing reaction of original and fake coins with conc. HCl.

Result and Discussion

Morphological analysis of original notes for exploring security features:

- The samples of 7 notes were collected and analysed.
- The security features like increasing serial number size in order, water mark of Gandhi, "RBI and Bharat " wording on Gandhi's collar and spectacles were observed.
- The RBI wording was seen in the designs of margin of notes.
- The Moiré's effect was seen.
- There was agradual increase in size of serial number.
- Magnetic strips were seen embedded inside thenote on which RBI was written.

Table: 1 Showing chart of note specimens analysed for key identification security features:

Sample Number	Specimen sample	Keyidentifying security features
S1		1. Moire's effect 2. RBI wording on spectacles 3. Magnetic strip 4. Serial.noinincreasing size 5.RBI, India wording on Gandhi's collar 6,7,8-wording of RBI on the margins.
S2		1. Increasing insize of serial.no 2. Moire's effect 3. Watermark of Gandhi 4. Magneticstrip 5. RBI on spectals 6,7 RBI words on collar and on margins.
S3		1. Moire's effect 2. RBI Wording on Gandhi's spectacles. 3. Watermark of Gandhi 4. Magneticstrip 5. Serial. Noin increasing order. 6,7,8 are the RBI wording on collar of Gandhi's and at the borders.

Like the above samples weeven performed analysis for 20rs, 200rs, 500rs and 2000rs.

By the above experiment we were able to differentiate between original and counterfeit currency and managed to identify maximum differences between original and fake notes and explored the security features given by RBI for Indian currency.

In coins we were able to clearly differentiate between original and counterfeit by acid test (conc. HCl) where, original coins did not react much and persisted their own colour and form but, counterfeit coins turned black along with the evolution of blackish fumes and bubbles were formed on the surface of the coins which is due to the metal reaction with the acid.

The possibility that this reaction may be due to the change in metal composition of fake and original coins.

Conclusion

By this we can conclude that people cannot easily distinguish between real and counterfeit currency which may lead to circulation of fake currency in the society. And as a forensic analyst we can differentiate counterfeit currency through scientific techniques as well as by using certain instruments also, by which we can help law enforcement agencies in preventing crimes related to fake currency smuggling, illegal selling fake currencies for higher prizes, damaging Indian economy that is crime against nation and much other aspects.

As a forensic expert, by following certain ethics and rules, we can prevent such kind of crimes and be a responsible citizen of the nation.

Limitations

- Sample collection of counter feit currency was difficult because of least availability.
- Sample collection was limited because it is illegal to possess counter feit currency.
- For fake note analysis certain tests like solubility test and burning tests are there. but it is not prescribed because it is a destructive method.
- Byacid test we can just identify the reaction occurring, but we cannot confirm the type of metal and composition of the metal can't be analysed.
- There are many more security features in Indian currency, but RBI made it confidential and doesn't reveal to the public in order to secure the country.

Scope for further enhancement

This study opens the scope for further research in understanding the techniques and methods used by the culprits to develop counterfeit currency in order to avoid crime as well as to enhance much more high security features to Indian currency so that no one can easily pyrite our currency.

It is self funding.

Conflict of interest: Nil

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