Detection of Forgery in Iraqi Banknotes of Denominations (25 and 10) Thousand Dinar and Matching Them with the Original Currencies by Microscopic Detection

Baraa Kasim Mohammed[1] and Bayda Khalaf Jabbar[2]

[1]Department of Forensic Sciences, College of Sciences, Al-Karkh University of Science, Baghdad, Iraq

[2]Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq

DOI: https://doi.org/10.51584/IJRIAS.2025.100500045

Received: 25 April 2025; Accepted: 29 April 2025; Published: 06 June 2025

ABSTRACT

The crime of counterfeiting was known and emerged with the emergence of writing and its widespread use in various aspects of life. The creation and circulation of counterfeit banknotes is currently on the rise, as a result of the progress in color printing technology. This is a serious issue that practically affects all countries and has had a negative impact on developing countries such as Iraq. Therefore, this research sheds light on the ways in which technology can enhance financial independence and honesty in the use and circulation of paper money by detecting it using unconventional methods. This is a crucial step towards increasing access to and control over financial resources. This research includes a method for displaying counterfeit and forged currency through its image, as counterfeit and forged banknotes of denominations (10000, 25000) Iraqi dinars were detected in the laboratory using an optical electron microscope. The results showed the most important differences and distinguishing marks in each denomination, as each denomination contains a distinctive mark through which the original and counterfeit currency can be detected. These results presented the most important steps through which it is possible to uncover an important crime that has been increasing at the present time compared to the progress of technology, as the methods of forgery, counterfeiting and imitation of currencies and official and unofficial documents have multiplied.

Keywords: forgery, paper currencies, detection, chemical methods.

INTRODUCTION

The crime of forgery was known and originated with the emergence of writing and its widespread use in various aspects of life,(1)but writing developed with the development of civilizations and with the increase in human awareness, documents, papers, and identity documents emerged, which were exposed to various types of signature forgery(2)Forgery is a change to the truth with the intent to deceive in one of the ways stipulated by law, a change that may cause harm, while counterfeiting focuses on imitation such as currencies (3).

whether paper or metal, postage and financial stamps, valuable papers and coins, and this is done by imitating them in any way to be similar to the original, and it is considered an infringement on the sovereignty of the state and its financial integrity and has many effects and disadvantages on the state's economy, its reputation, and the confidence of countries and the public in their currencies.(4)Central banks seek to protect their banknotes, whether by enhancing their security specifications from time to time or by imposing penalties on those who carry out the forgery process (5).

The process of making money consists of several stages, but nevertheless, the process of counterfeiting money is one of the most common fraudulent operations throughout the ages, and it is one of the most widespread operations around the world(6).Counterfeiting money means making money that is similar and identical to the original currency with high craftsmanship, but it is money without any value that can be discovered in several ways despite its conformity to the original currency(7).Counterfeit money is money that some people try to use and trade as real money for the purpose of deception.(8)Counterfeit money of various currencies and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

denominations, whether through counterfeiting coins or paper money, may pose a continuous threat to any country or person, due to its significant impact on the value of the real currency. (9)Therefore, the state resorts to including some details and marks to distinguish the real currency from the counterfeit, so security threads are added as a means of making the counterfeiting process difficult.(10)These threads are placed vertically outside the center of the paper during its manufacture, and these threads can be easily seen when exposing the banknotes to light, as this thread appears as a broken line.(11)Counterfeit money is known as making money that is very close to the original money in terms of shape with high craftsmanship, but it is worthless money and is used for the purpose of deception, and it may pose a continuous threat to society and individuals due to its significant impact on the value of the original currency.(12,13)The study aims to clarify the concept of forgery and counterfeiting and to identify its elements, and to clarify the damage and its forms in this crime through a group of samples to detect them using modern practical methods.

Research samples

The research includes two types of paper currencies, which are denominations of (25,000), (10,000).The original currencies were compared with counterfeit currencies of the same denomination.

Study preparation and design:

The current test was planned to be a descriptive examination to detect counterfeit currencies. Starting in November 2023, the work included collecting counterfeit and original currencies. and studying the most important differences between them. The optical electron microscope was used to detect currencies, as this device contains a light source.

First, the sample is placed on a glass slide. The sample to be examined must be thin enough to be transparent. Then, the slide with the sample inside is placed over an opening in the microscope table. Through a light source, such as a lamp fixed in the base, the light is directed upwards. The light passes through the sample and the objective lens located directly above the sample, and is magnified. Then, the magnified image is projected through the reed (body tube) towards the eyepiece, and becomes even more magnified. The larger objective lens in the microscope magnifies an image to 100 times the original size of the sample, while the eyepiece magnifies 10 times the original size.

Figure (1): shows the image of the optical electron microscope.

RESULTS

The results showed the most important differences and distinguishing marks in each category, as each category contains a distinguishing mark through which the original and counterfeit currency can be detected. The data were summarized, presented, the results were interpreted, and the most important basic points responsible for identifying and distinguishing counterfeit currencies from genuine currencies were clarified.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

Figure (2): shows a normal image of the original (highest) and counterfeit (lower) 25000 class, front side and the other side.

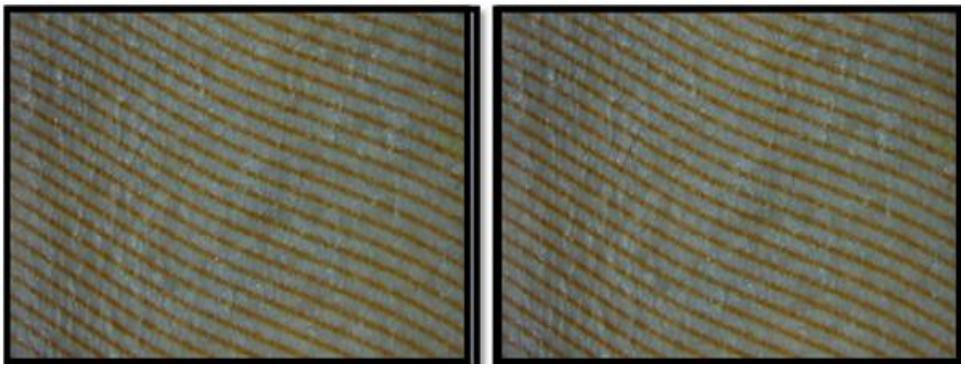


Figure (3): shows a microscopic image of the original (left) and the counterfeit (right) 25000 watermark.

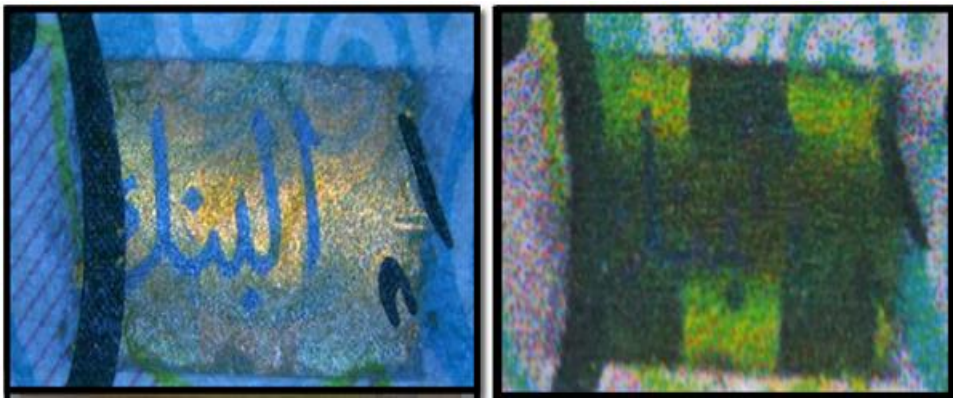


Figure (4) shows a normal image of the original (left) and counterfeit (right) 250000 series security thread.

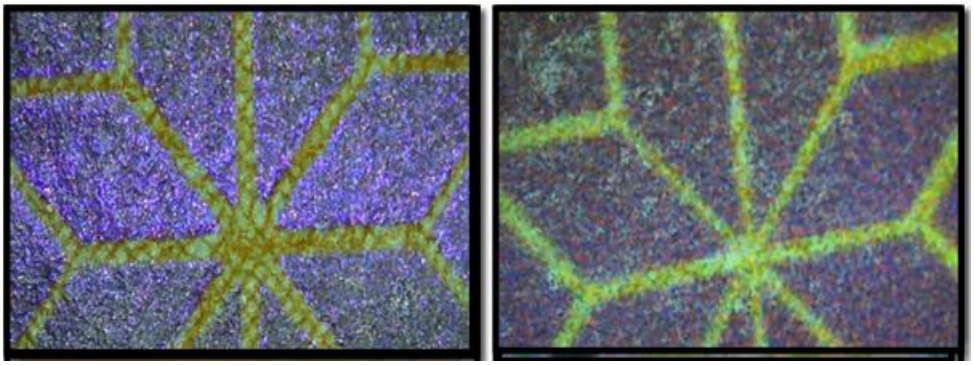
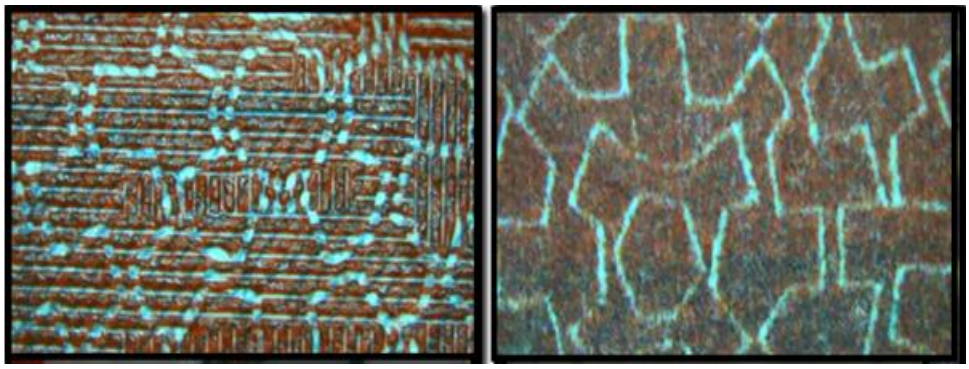


Figure (5) shows a microscope image of the original (left) and counterfeit (right) 25000 series optically variable ink**.**

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

Figure (6) shows a microscopic image of the original (left) and counterfeit (right) 25000 class transparent window.



*This part is an addition to the security marks mentioned and was added by researchers

Figure (7) shows a microscopic image of the original (left) and counterfeit (right) 25000 denominations.

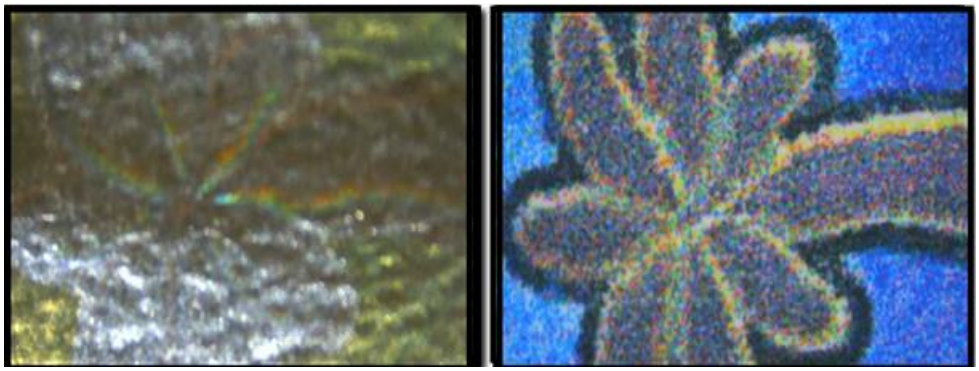


Figure (8) shows a normal image of the original (left) and counterfeit (right) 25000 class phosphorescent mark.

Figure (9) shows a normal image of the original (highest) and counterfeit (lower) 10,000 denomination front sides.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

Figure (10) shows an under-microscope image of the 10,000 class of the original (left) and Counterfeit (right) watermark**.**

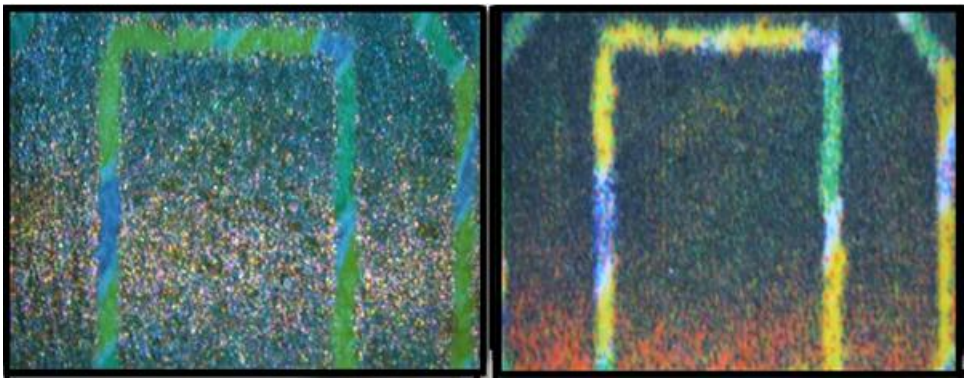


Figure (11) shows an under-microscope image of the 10,000 grade of the original (left) and Counterfeit (right) optically variable ink.

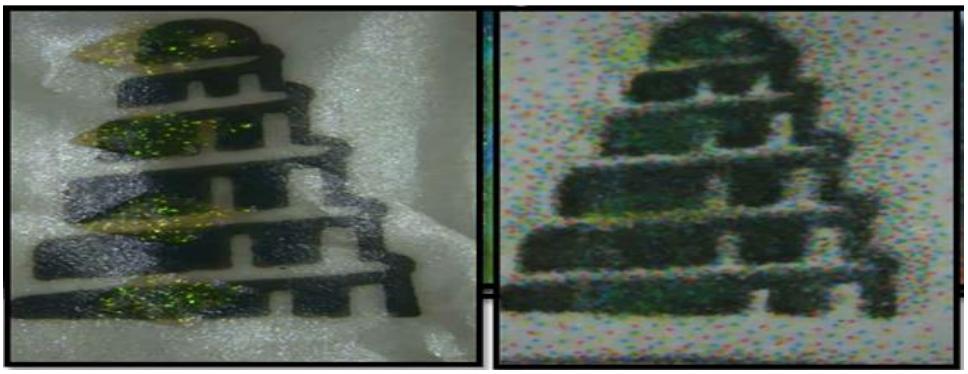


Figure (12) shows an image under a 10,000 class microscope of the original (left) and Counterfeit (right) transparent window**.**

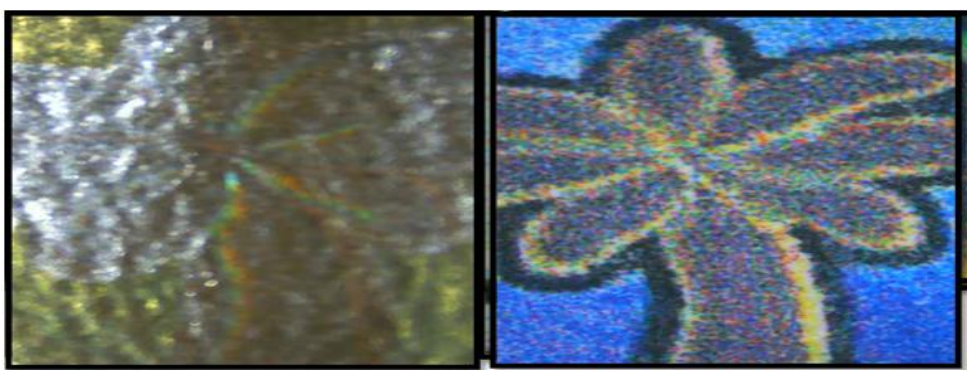


Figure (13) shows a normal image of the 10,000 series of the original (left) and Counterfeit (right) phosphorescent marker**.**

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

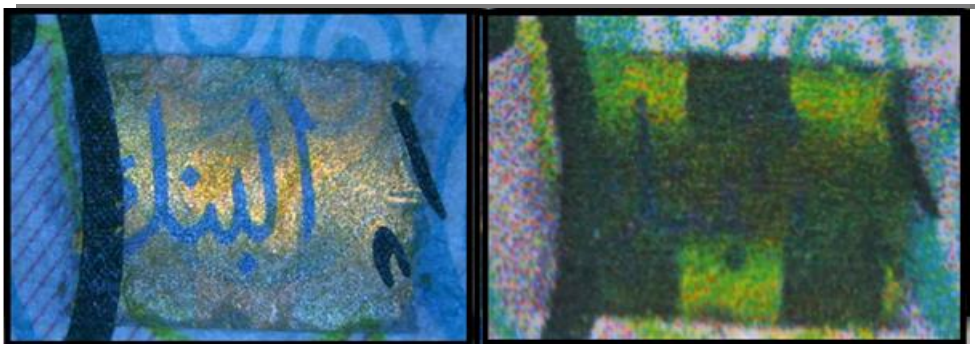


Figure (14) shows a normal image of the 10,000 series of the original (left) and Counterfeit (right) phosphorescent marker**.**

DISCUSSION

Counterfeit copies can be identified from the original copies of currencies, by knowing the security marks on Iraqi currencies, for example, the original Iraqi currency of the denomination of (ten thousand and twenty-five thousand dinars) contains four security marks and these marks are as follows:(1)Transparent window: Its characteristics include the appearance of the image of the spiral if its background is white, and the denomination number appears if its background is black.(a)In the original twenty-five thousand denomination, the transparent window contains the image of the spiral and the denomination number, but in the case of counterfeiting, it lacks the image of the spiral and the denomination number.(b)In the original ten thousand denomination, the transparent window contains the image of the spiral and the denomination number, but in the counterfeit, the window is not transparent and does not contain the denomination number.(2) Security line: It is a line made of metal or plastic placed vertically and integrated into the paper and appears intermittently in the paper and carries the following phrase (Central Bank of Iraq).These words are difficult to see directly. We used a microscope to see them. In all categories, the difference between the original and the counterfeit is in the inks used in the paper, as the colors of the original paper are clearer and brighter, while the colors of the counterfeit paper are dim. (1)Watermark: It is a high-tech physical optical event that exists inside the papers and is not seen unless the paper is exposed to penetrating light. There is a drawing in the shape of a (horse's head) in Iraqi currencies of all categories. Also, when using a microscope, we will see straight, arranged lines, while in the counterfeit there are no lines, but rather they are in the form of dots, and even the shape (horse's head) does not appear when light passes through the paper. This feature exists in all categories. (2)Optically variable ink: It is a printing ink that contains a high-resolution interference filter in a small structure and displays two different colors when looking at the original paper straight or sideways under natural light. When the viewing angle of the eye changes, it presents two colors Different. While the counterfeit is fixed and does not change because these inks are special for combating counterfeiting and the color angle effect cannot be reproduced by any high-resolution scanner or color copier or any other device. This mark is found in all categories.In the ten thousand and twenty-five category there is a phosphorescent mark in the shape of a (palm tree) that is parallel to the transparent window, when looking at it is silver but when it is copied or a picture of it is taken it will be colored with certain shiny colors, so if this mark is colored then this currency is counterfeit.

CONCLUSIONS

These results presented the most important steps through which it is possible to reach the detection of an important crime that has been increasing at the present time compared to the progress of technology, as the methods of forgery, counterfeiting and imitation in official and unofficial currencies and documents have multiplied. The possibility of determining the difference between forgery and counterfeiting in paper currencies has become an important issue at the present time. Studies and research must be focused on this topic. One of the most important duties of the criminal investigator is to have experience in this aspect to reduce this problem.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

REFERENCES

1. Ehrman, B. D. (2012). Forgery and counterforgery: the use of literary deceit in early Christian polemics. Oxford University Press.
2. Ibitoye, O. T. (2024). Fake Currency Detection using Modified Faster Region-Based Convolutional Neural Network. International Journal of Electrical Engineering and Computer Science, 6, 46-50.
3. Arifin, M. (2017). Changing Money Viewed From Positive Law and Islamic Law. KUMPULAN JURNAL DOSEN UNIVERSITAS MUHAMMADIYAH SUMATERA UTARA, 8(10).
4. Britannica, T. Editors of Encyclopaedia (2024, October 7). forgery. Encyclopedia Britannica. https://www.britannica.com/topic/forgery-law
5. Allen, S., Čapkun, S., Eyal, I., Fanti, G., Ford, B. A., Grimmelmann, J., ... & Zhang, F. (2020). Design choices for central bank digital currency: Policy and technical considerations (No. w27634). National Bureau of Economic Research.
6. Hilal, W., Gadsden, S. A., & Yawney, J. (2022). Financial fraud: a review of anomaly detection techniques and recent advances. Expert systems With applications, 193, 116429.
7. Desai, S., Rajadhyaksha, A., Shetty, A., & Gharat, S. (2021). CNN based Counterfeit Indian Currency Recognition Using Generative Adversarial Network. 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS), 626-631.
8. Doush, I. A., & Sahar, A. B. (2017). Currency recognition using a smartphone: Comparison between color SIFT and gray scale SIFT algorithms. Journal of King Saud University-Computer and Information Sciences, 29(4), 484-492.
9. Finlay, R., & Francis, A. (2019). A Brief History of Currency Counterfeiting| Bulletin–September 2019.
10. Centeno, A. B., Terrades, O. R., Canet, J. L., & Morales, C. C. (2019). Identity Document and banknote security forensics: a survey. arXiv preprint arXiv:1910.08993.
11. Berenguel Centeno, A. (2019). Analysis of background textures in banknotes and identity documents for counterfeit detection.
12. Bandu, S.C.D., Kakileti, M., Jannu Soloman, S.S. et al. Indian fake currency detection using image processing and machine learning. Int. j. inf. tecnol. (2024). https://doi.org/10.1007/s41870-024-02170-9
13. Smith, L., & Quercioli, E. (2014). Counterfeit Money. Encyclopedia of Law and Economics, edited by Juergen Backaus, Springer New York, Forthcoming.