

A Comparative Study between £10 and EGP-10 Polymeric Notes

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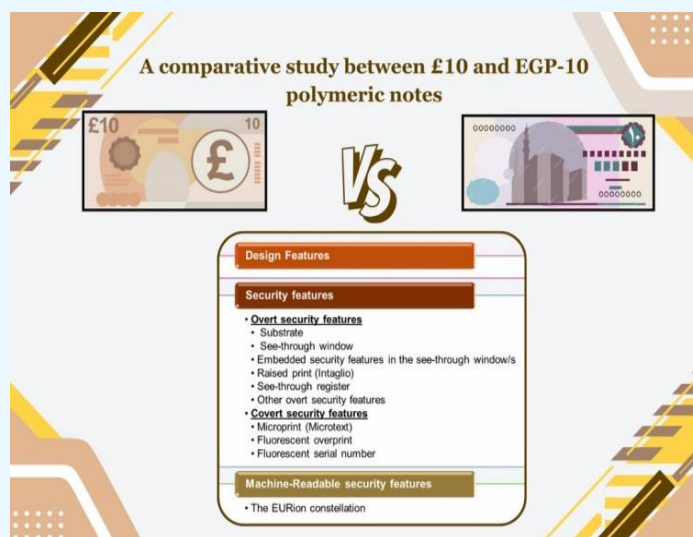
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ABSTRACT: This study examines the security features used in polymer banknotes by comparing the new polymeric 10-Egyptian banknote and its English counterpart notes. Video Spectral Comparator 8000/HS (VSC 8000/HS) and visual inspection were used to study and compare the security features of both banknotes. There are similarities between the design of the two banknotes, which is undesirable from a security point of view. Still, the English banknote is superior to its Egyptian counterpart in design and security features. Although many studies deal with the security features of banknotes, with many countries switching to polymer banknotes every year, such as Egypt recently, there is a need for more studies on securing the polymer substrate and comparing the security features used in polymer banknotes. This study offers the first structured, side-by-side forensic mapping of overt and covert security features across two same-denomination polymer banknotes—EGP-10 and £10. Standardised visible/IR/UV examinations (transmitted/oblique; VSC8000/HS) contrast design strategies with direct implications for counterfeit detection and examiner training.



1. INTRODUCTION

Banknotes are essential in transactions, whether between individuals or societies. They represent the safe mediator agreed upon by all parties for the transactions. Since the invention of banknotes as a means of monetary dealing, banknote counterfeiting has appeared. Even ancient Chinese coins have been imprinted with a warning against counterfeiting and a threat to punish those who commit it [1].

Currency counterfeiting is one of the most dangerous crimes that countries face because it has a devastating effect on the economy. Therefore, countries have been keen to update their

currencies continuously and add new security features [2]. But this did not prevent counterfeiters from trying to imitate these features. The burden of banknote counterfeiting has increased in recent years due to the massive development of photocopiers and computer printers, which have facilitated banknote counterfeiting and enabled counterfeiters to produce high-quality counterfeit notes, representing a great challenge for all security authorities worldwide [3].

Australia has taken a significant step in the field of banknote security by replacing paper with polymer, which resulted in new security features for polymer substrates not found in paper banknotes [4]. International experiences have proven that this matter has tremendously impacted combating counterfeiting. The level of counterfeiting in several countries, such as New Zealand and Brazil, decreased dramatically, reaching 98% in Romania [5].

Polymer banknotes are made of biaxially oriented polypropylene (BOPP), which was chosen for its durability and resistance to delamination [4]. The most prominent manufacturers of polymeric substrates for banknotes are the Australian CCL Secure and the English De La Rue companies. CCL Secure produces GUARDIAN [6] and SPARTAN [7] substrates, and De La Rue producing SAFEGUARD substrate [8].

Polymer banknotes are distinguished from traditional paper banknotes in terms of durability, hygiene, and production cost [3]. Paper banknotes have a porous nature, so they are good incubators for microbes, such as *E. coli*. Elleboudy et al [9] have advised covering the paper banknotes with a layer of varnish or switching to polymer instead of paper to reduce this phenomenon. Another study conducted in Mexico also confirmed that polymer banknotes have a better impact on the environment in terms of both manufacturing and disposal [10]. Also, many studies dealt with the switching cost from paper banknotes to polymers, and despite the high initial cost of manufacturing polymer banknotes, it is more economical in the long run, this is due to its long-life cycle compared to the traditional paper banknotes, Australia recorded a net benefit around 90 million Australian dollars in the ten years of its transition to polymer banking [11].

As a result, many countries decided to switch completely or gradually to polymeric currencies, according to Bandyopadhyay [12]. Those countries reached 76 out of the world's 195 countries; Egypt has kept pace with this change and issued the first polymer banknotes of the ten-pound denomination in July 2022.

Many security features are compatible with the polymer substrate, so each country chooses what it guarantees to its currency to achieve the required degree of security in a way that expresses its identity. This study compares the £10 and EGP-10 notes in terms of security features and how well they express the identity and culture of the issuing country.

2. Materials and Methods

2.1. Samples

Two genuine polymeric banknotes of the same denomination were examined: the Egyptian EGP-10 (2022 series, Central Bank of Egypt) and the Bank of England £10 (2017 polymer series). No cleaning, flattening, or chemical treatment was performed. Notes were handled with powder-free nitrile gloves.

2.2. Substrate and Chemistry

Both notes were printed on a biaxially oriented polypropylene (BOPP) polymer substrate. The Bank of England £10 (2017) was issued on Guardian® (BOPP-based) substrate, and the Egyptian EGP-10 (2022) likewise uses Guardian® polymer. Detailed formulations are proprietary, but BOPP is a non-porous polypropylene film typically opacified and over-varnished for printability.

2.3. Instrumentation

2.3.1. Video Spectral Comparator 8000/HS (VSC 8000/HS)

VSC 8000/HS (Foster & Freeman) is the most advanced questioned document examiner workstation, containing digital imaging and multi-wavelength [13]. VSC-8000 was used to study security features in Egyptian and English 10-polymeric notes.

Imaging modes used:

- Visible (reflected): broadband white illumination for general feature mapping and colour/print inspection.
- Oblique illumination (visible/NIR): two adjustable oblique light heads (white and ~850 nm LEDs) used to enhance surface relief of tactile/intaglio-like elements and window edges.
- Transmitted illumination (visible/NIR): uniform transmitted white and ~850 nm LED backlighting; an optional high-intensity ~20 W halogen transmitted spot (~25 mm diameter) for localised through-print/window inspection.
- Ultraviolet-induced fluorescence (UV-A): incident long-wave ~365 nm for visualisation of fluorescent overprints and security fibres. (Short-wave UV modules may be available depending on configuration; not used unless specified.)

Both notes were applied to the same illumination presets and exposure settings to enable side-by-side comparison under reproducible conditions. System calibration and white balance were performed before each session, following the standard operating procedure.

2.3.2. Plugable 250x Digital USB Microscope

Digital microscope with magnification power from 60x to 250x.

All examinations were non-destructive and conducted per established forensic document examination practice, using configurations that do not alter the specimens.

3. Results and Discussion

3.1. Design Features

Banknote design features are not limited to including security features that protect the banknote from counterfeiting; they should also express the national identity and culture of the issuing country [14].

The new Egyptian 10-pound note is the first polymeric banknote in circulation. It was launched in July 2022 and is approximately 13.3 x 6.9 cm. As it is a polymeric banknote, it has a transparent window to the left of the face of the note. On the face is an image of the Al-Fattah Al-Alim Mosque in the new administrative capital, a mosque mihrab, Islamic decorations, and the two serial numbers of the banknote, horizontal and vertical. The denomination of the currency, in Indian numerals, is in the upper right and lower left corners, and in the middle is the name of the issuing bank, the value of the currency, and the signature of the governor of the Central Bank, written in Arabic as shown in [Figure 1a](#).

In the back is a portrait of the statue of the pharaonic Queen Hatshepsut, the Great Pyramid, and the Library of Alexandria, as well as the lotus flower and part of the three pyramids on the right. The banknote denomination is written in English letters and Arabic numerals on the left of the note below the issuing bank's name, as shown in **Figure 1b**.

The sterling 10-pound note was issued in September 2017; it has the same size as the EGP-10 (approximately 13.3 x 6.9 cm) and has transparent windows. It is called Jane Austen note, the famous English novelist, 1775- 1817, because it commemorates her legacy. On the back of the note is a portrait of Jane Austen and two images celebrating Austen's work. Her work also inspires the background, and there is a quote from her novel *Pride and Prejudice* under her portrait and her signature [15], as well as a security feature in the shape of a book containing her initials. There is also the denomination of the note "£10" and two serial numbers of the

banknote, one is horizontal and the other vertical, as shown in **Figure 2b**.

On the face, there is the Queen's portrait on the right side, and on the see-through window, there is a smaller version of the Queen's portrait, an image of Winchester Cathedral, the resting place for Jane Austen, with gold, the "£" symbol, and a quill. Also, there are many other elements such as the coronation crown, the name of the issuing bank, the denomination of the currency, and the signature of the chief cashier of the Bank of England, as shown in **Figure 2a**.

A visual examination of the two banknotes showed a similarity between them:

- The color schemes.
- The size.
- The type of fonts used in the issuing bank's name and the currency's value in the back, as shown in **Figure 3**.



Figure 1. EGP-10 note (a) the face side, (b) the back side.



Figure 2. £10 note (a) the face side, (b) the back side.



Figure 3. The fonts on the back of the two notes.

These similarities may be because the same company, the English De La Rue company, designed the two notes, as announced. However, this is undesirable from a security point of view as it facilitates a special type of money counterfeiting-altered banknotes-which means getting counterfeit banknotes by raising the value of genuine notes.

As shown in [Figure 4](#), the £10 note has two clusters of raised dots in the top left corner of the front, which is a tactile feature for blind and visually impaired people. The Egyptian note lacks this feature.



Figure 4. Tactile feature on the £10 note.

Finally, the design of the £10 is richer than that of the Egyptian 10-pound note because it contains many elements that integrate harmoniously to celebrate the English writer Jane Austen and her work as a symbol of English culture. In contrast, the civilizational symbols in the Egyptian currency are limited, scattered, and not linked to each other.

3.2. Security Features

Banknotes are classified as high-tech security products [16]. They contain a large and diverse number of security features. There are two main ways to classify security features. The first one is according to the ability to detect and identify them into 1) Overt features, which are features that can be detected and identified directly using the human senses in normal light without using any aiding tools, 2) Covert features, which need aiding tools – such as magnifying lenses or different types

of rays – to detect and identify them, and 3) Machine-Readable features that can be detected and identified automatically in the absence of a human being [17]. The second classification is based on the origin of those security features. It identifies them into 1) features related to the substrate, 2) features related to printing methods, and 3) features related to the inks used. Both classifications are accepted and used in the scientific literature; in that paper, the first classification is mainly used to compare the Egyptian and English ten banknotes.

3.2.1. Overt Security Features

It represents the first level of protection against counterfeiting and depends on the senses of touch and sight.

3.2.1.1. Substrate

Both Egypt's and England's 10-note banknotes are made from polymer substrate instead of paper, which is a qualitative leap in the banknotes industry and document security, which was started by Australia in 1988 after research and scientific effort that took twenty years until the first polymeric note appeared [18].

As announced, the Bank of England is using De La Rue's SAFEGUARD® polymer as a substrate for the £10 print, while the Central Bank of Egypt uses both of De La Rue's SAFEGUARD® substrates interchangeably with CCL Secure's GUARDIANTM [19]. Both substrates are biaxial polypropylene BOPP and are unavailable commercially [3].

Despite the advantages of polymer notes over paper ones regarding durability, hygiene, and new security features, paper notes are superior to polymeric notes in terms of the distinctive texture.

3.2.1.2. See-Through Window

A see-through or transparent window is an essential feature in all polymer banknotes. All notes must contain at least one transparent window, but some notes have more than one window that differ in size, shape, and other security elements loaded on them.

The ten-Egyptian note has one large window loaded with two security elements, while the £10 note has two large overlapping windows and two small windows in a decorative shape. The two large overlapping windows carry four security elements, as shown in [Figure 5](#).



Figure 5. See-through windows on both notes: (a) £10, (b) EGP-10.

3.2.1.3. Embedded Security Features in the See-Through Window/s

Polymer substrate provides a medium for new security

features, such as embedded features in the transparent window [4]. The main embedded security features are optical variable devices (OVDs), which are defined as elements that change their appearance according to changes in

external things to the note, such as the viewing angle or temperature [5].

The ten-Egyptian note has two embedded optical variable devices (OVDs) on its see-through window. The first is a miniature hologram image of the new administrative capital's grand mosque, Al-Fattah Al-Aleem, which appears silver on the front and golden on the back. A multicoloured rainbow effect can be seen when the note is tilted, as shown in [Figure 6](#).

The second is an ornate hologram containing the number "10" in Indian numerals, also shown in silver on the front and gold on the back, and gives different colours by tilting the note as shown in [Figure 6](#).

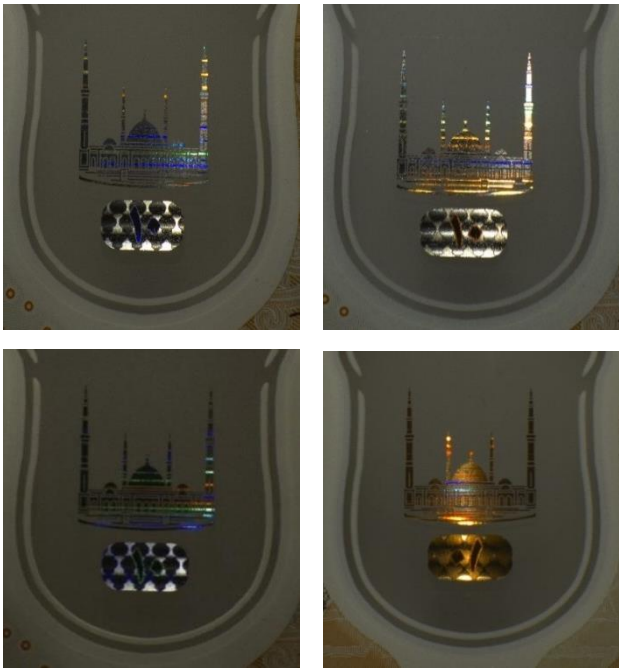


Figure 6. Embedded security features in the see-through window of the EGP-10 note.

While the two overlapping windows in the £10 note have four security features:

- Metallic hologram of Winchester Cathedral-most of it on the transparent window and a small part above it from the front of the note-the hologram appears gold on the front and silver on the back, and when the note is tilted, a multicoloured rainbow effect can be seen, as shown in [Figure 7](#).
- Foil '£' symbol appears silver on the front and copper on the back as shown in [Figure 7](#).
- Colour-changing quill whose colour changes from purple to orange by tilting the note as shown in [Figure 8](#).
- A printed portrait of the Queen with "£10 Bank of England" printed twice around the edge as shown in [Figure 9](#).

3.2.1.4. Raised print (Intaglio)

'Feel' is one of the key steps in any rapid banknote screening protocol. Therefore, banknotes contain raised printing-intaglio-in several places as a security feature [20]. Both notes

only have intaglio printing on the face. The EGP-10 note has four places containing intaglio printing, as shown in [Figure 10](#), while the intaglio printing is found in five locations in the £10 note, as shown in [Figure 11](#).

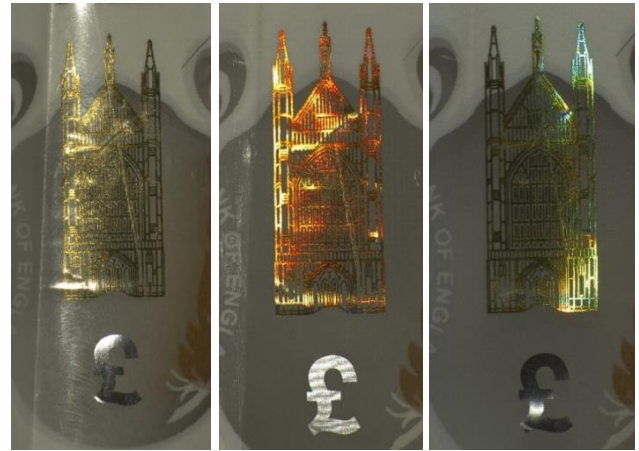


Figure 7. Metallic hologram of Winchester Cathedral & the foil '£' symbol on £10 note.



Figure 8. Colour-changing quill on £10 note.



Figure 9. The Queen's portrait on a £10 note in the see-through window.



Figure 10. The intaglio printing on the EGP-10 note.



Figure 11. The intaglio printing on the £10 note.

3.2.1.5. See-Through Register

A see-through register is an image, part of which is printed on the face and the other part on the back. The image is completed when viewed with transmitted light. On EGP-10, it appears in the form of a lotus flower on the left side of the face, as shown in [Figure 12](#).

On the £10 note, the Winchester Cathedral image is incomplete from the back, but completes when viewed with transmitted light, as shown in [Figure 13](#).

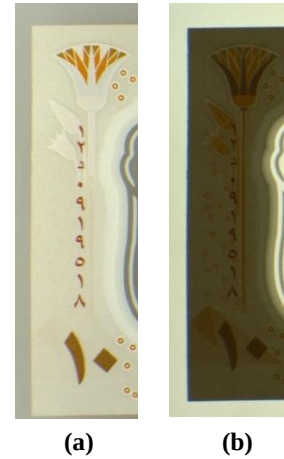


Figure 12. The see-through register on an EGP-10 note: (a) From the front, (b) With transmitted light.

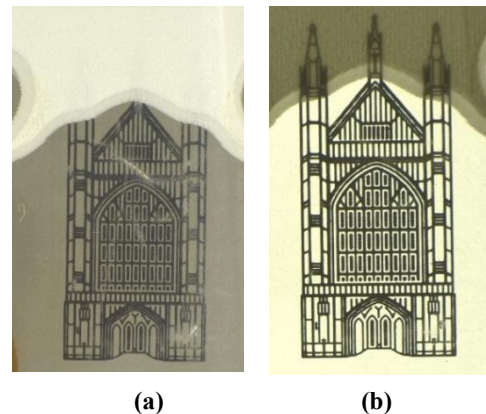


Figure 13. The see-through register on a £10 note: (a) From the back, (b) With transmitted light.

3.2.1.6. Other Overt Security Features in EGP-10 note

The number “10” in copper in the lower left corner of the face of the note shimmers when tilted as shown in [Figure 14](#).



Figure 14. Shining number on EGP-10 note.

3.2.1.7. Other overt security features in the 10-Sterling note

3.2.1.7.1. Hologram image change

A hologram below the see-through window on the face contains the word “pounds,” which changes to “Ten” by tilting the note, as shown in [Figure 15](#).

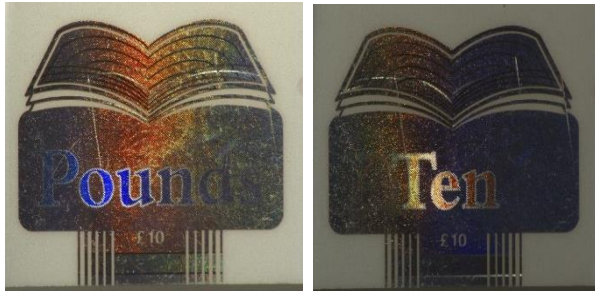


Figure 15. Hologram image change on £10 note.

3.2.1.7.2. Silver Foil Patch

A silver foil patch contains a 3D image of the coronation crown above the see-through window on the front of the note, which displays a multicoloured rainbow effect when the note is tilted, as shown in [Figure 16](#).

3.2.1.7.3. Copper foil patch

A book-shaped copper foil patch contains the letters 'JA', which refer to the English writer Jane Austen, whose portrait is

on the back of the note. By tilting the note, different shapes and colours appear in the background, as shown in [Figure 17](#).

3.2.1.7.4. Horizontal serial number

The horizontal serial number on the back of the note is multicoloured as shown in [Figure 18](#).

Key overt security features of the EGP-10 and £10 are summarised side by side in [Table 1](#).

3.3. Covert security features

They are features that need aiding tools, such as magnifying lenses and ultraviolet rays, to be detected and identified.

3.3.1. Microprint (Microtext)

They are fine writings 15-90 microns high that appear with normal vision in the form of continuous lines or geometric shapes, and it is difficult for traditional copying devices to reach this level of printing accuracy [16].

In the EGP-10 note, microprinting is found in two places on the face, as shown in [Figure 19](#), and three places on the back, as shown in [Figure 20](#). In contrast, the £10 note contains microprinting in many places on the face and the back, as shown in [Figures 21 & 22](#).



Figure 16. Silver foil patch on £10 note.



Figure 17. Copper foil patch on £10 note.

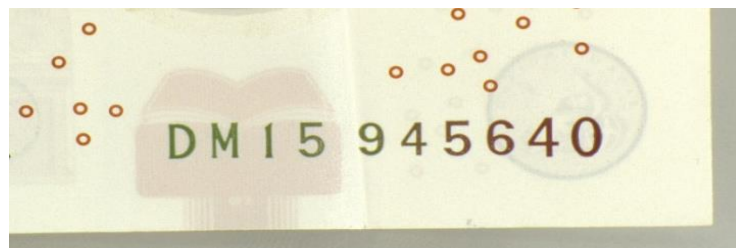


Figure 18. Multicoloured serial number on £10 note.

Table 1: Summary of the overt security features in two notes.

Security Features	£10	EGP-10
Substrate	GUARDIAN™	GUARDIAN™ & SAFEGUARD®
See-through window	Two large overlapping windows and two small windows are in the form of a decorative shape.	One window
Number of embedded security elements in the see-through window/s	4	2
Embedded security elements in the see-through window/s	- Metallic hologram of Winchester Cathedral Front – Gold Back – Silver - Multicoloured rainbow effect by tilting	- Hologram image of Al-Fattah Al-Aleem Mosque Front – Silver Back – Golden - Multicoloured rainbow effect by tilting.
	- Foil “£” symbol Front – Silver Back – Copper	- Ornate hologram containing the number “10” in Indian numerals, Front – Silver
	Colour-changing quill Purple --- tilt --- Orange	Back – Golden - Different colours by tilting.
	A portrait of the Queen with “£10 Bank of England” was printed twice around the edge.	
Raised print (Intaglio)	The number “10” in the top right corner	The number “10” in the top right corner
	The large number “10” and the small “10” numbers around it in the lower right corner of the face of the note	
	Portrait of the Queen	Image of Al-Fattah Al-Aleem Mosque
	The words: “Bank of England”, “I PROMISE TO PAY THE BEARER ON DEMAND THE SUM OF TEN POUNDS”	The words: “عشرة جنيهات”, “البنك المركزي المصري”
	The words: “Ten Pounds”	Signature of the Governor of the Central Bank of Egypt “طارق حسن عامر” and the word “المحافظ”
See-through register	The Winchester Cathedral image on the back	Image of a lotus flower on the left side of the face
Other overt security features in the 10-Egyptian note	----	The number “10” in copper in the lower left corner of the face of the note shimmers when tilted.
Other overt security features in the 10-Sterling note	Hologram image change ‘pounds’ ---- ‘Ten’	-----
	3D Silver foil patch of the coronation crown on the face	
	A copper foil patch in a book-shaped contains the letters ‘JA’ on the back Tilting ---- Different shapes and colours appear	
	The multicoloured horizontal serial number on the back	

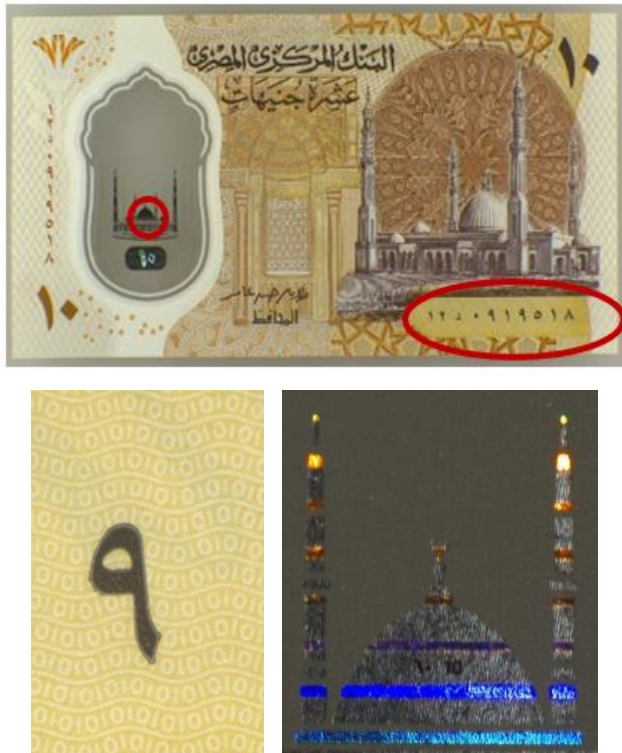


Figure 19. Microprint on the face of the EGP-10 note.



Figure 20. Microprint on the back of the EGP-10 note.



Figure 21. Microprint on the face of the £10 note.



Figure 22. Microprint on the back of the £10 note.

3.3.2. Fluorescent overprint

It is invisible ink in normal light and only appears bright under ultraviolet rays.

Each of the two banknotes has one element of UV-fluorescent ink on the face. In the EGP-10 note, Decorative colours—blue and gold—are used for the interior of the mosque's mihrab. Above them is the number 10, as shown in [Figure 23](#).



Figure 23. Fluorescent overprint on the face of the EGP-10 note.

The £10 note has a fluorescent overprint on its face and back. The number "10" on the face is bright red and green, as shown in [Figure 24](#). On the back is a square on Jane Austen's portrait, as shown in [Figure 25](#).



Figure 24. Fluorescent overprint on the face of a £10 note.



Figure 25. Fluorescent overprint on the back of the £10

3.3.3. Fluorescent serial number

The vertical serial number on the ten Egyptian pounds appears in gold, and when exposed to ultraviolet rays, it glows in copper, as shown in [Figure 26](#).



Figure 26. Fluorescent serial number on EGP-10 note note.

Key covert security features of the EGP-10 and £10 are summarised side by side in [Table 2](#)

Table 2: Summary of the covert security features in two notes.

	£10	EGP-10
Microprint (Microtext)	- Repetition of the number 10 (on the face). - Repetition of the number 10 (on the face). - Repetition of the word 'TEN' (on the face). - Repetition of the word "*TEN*" (on the face). - Repetition of the words "TEN POUNDS" (on the face). - Repetition of the words "TEN POUNDS" (on the face). - The words "© THE GOVERNOR AND COMPANY OF THE BANK OF ENGLAND 2016". - Repetition of the number 10 inside the normal 10 numbers and the letters 'BOE' in the background (on the back). - The words "BOE * TEN * 10 *BOE * TEN" (on the back). - Repetition of the word "TEN" (on the back). - Repetition of the letters "BOE" in the background (on the back). - Repetition of "*TEN*BOE" (on the back).	- Repetition of the number 10 (on the face). - Number ten twice in Arabic and Indian numerals (inside the image of Al-Fattah Al-Alim Mosque in the transparent window on the face). - Repetition of the number 10 (on the back).
Fluorescent overprint	Number "10" is bright red and green (on the face). A square on Jane Austen's portrait (on the back).	Decorative colours - blue and gold - for the interior of the mosque's mihrab, above them, the number 10 on the face.
Fluorescent serial number	----	The vertical serial number appears in gold; when exposed to ultraviolet rays, it glows in copper.

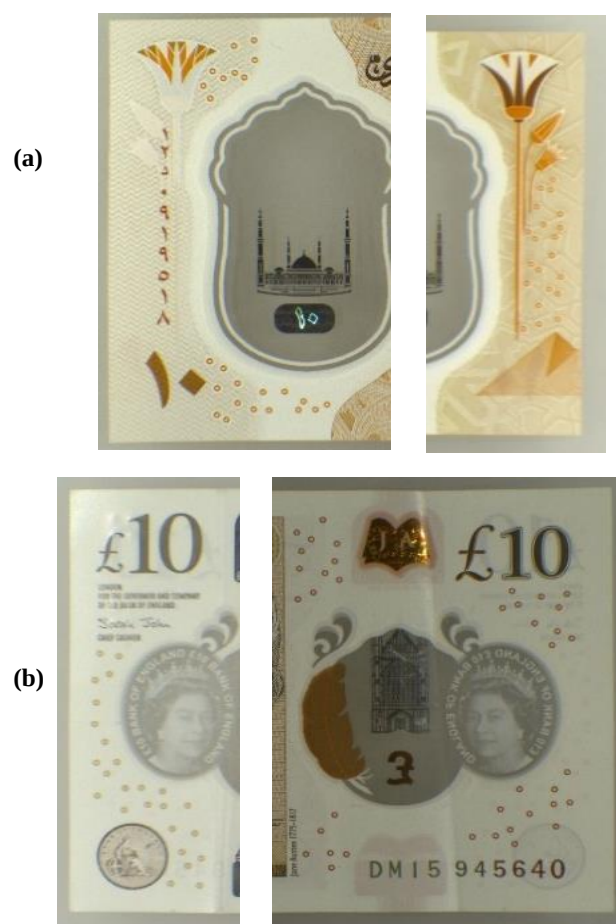
3.4. Machine-Readable Security Features

They are features that are detected by machines in the absence of a human being.

3.4.1. The EURion constellation

The EURion constellation is a geometric pattern consisting of a group of small orange, yellow, or green circles repeated in the front and back of a banknote. These patterns aim to allow imaging software to identify banknotes and prevent their reproduction [21].

Both notes have the EURion constellation on the front and back, as shown in [Figure 27](#).

**Figure 27.** The EURion constellation: (a) EGP-10, (b) £10.

3.5. Relation to recent studies

Recent comparative work surveying banknotes from multiple countries with a VSC-8000/HS reports that UV-induced fluorescence and IR response patterns reliably discriminate security features across issues [22]. Our findings align with that trend but add a denomination-matched, polymer-substrate perspective: beyond fluorescence and IR contrast, we detail differences in the architecture of transparent windows specific to the EGP-10 versus the £10. Complementing this, a 2023 review of polymer banknotes summarises the substrate's material structure, window constructs, and optical security technologies, reinforcing the relevance of non-destructive UV/IR/transmitted examinations for polymer notes [23]. These comparisons suggest that standard UV/IR/transmitted modes in an integrated VSC workflow already capture most diagnostically useful contrasts for polymer notes.

4. Conclusion

This study provides a denomination-matched, non-destructive comparison of overt and covert security features in two polymer banknotes—the Egyptian EGP-10 (2022) and the Bank of England £10 (2017)—examined under standardised visible/UV/IR, transmitted and oblique modes on a VSC system. Reflecting their common designer (De La Rue), the notes share several design elements; however, we document note-specific, operationally relevant differences in the topology of microtext, the architecture of transparent windows, and the behaviour of UV overprints, alongside observable differences in how design elements relate to a common theme—with the £10 referencing Jane Austen across portrait, microtext and supporting graphics. At the same time, the EGP-10 uses culturally oriented elements that are presented more independently. Practically, design parallels may elevate risk for altered-banknote fraud, while the mapped differences can be used to sharpen screening protocols and support examiner training. We also set out a concise, standardised examination methodology to support routine side-by-side comparisons and to serve as a reproducible reference baseline for polymer-note examinations in Egypt.

References

- [1] Finlay, R.; Francis, A. A Brief History of Currency Counterfeiting. Reserve Bank of Australia (RBA) Bulletin. 2019.
- [2] Mann, M.; Shukla, S. K.; Gupta, S. A Comparative Study on Security Features of Banknotes of Various Countries; *Int. J. Multidiscip. Res. Dev.* 2015, 2 (6), 83–91.
- [3] Goher, A. Supremacy of Polymer Banknotes: A Comparative Study Between Paper and Polymer Banknotes; Naif Arab University for Security Sciences: Riyadh, 2012.
- [4] Hardwick, B.; Jackson, W.; Wilson, G.; Mau, A. W. H. Advanced Materials for Banknote Applications. *Advanced Materials*, 2001, 13, 980-984.
- [5] Prime, E. L.; Solomon, D. H. Australia's Plastic Banknotes: Fighting Counterfeit Currency. *Angewandte Chemie International Edition*. 2010, 49 (43), 7724–7731. <https://doi.org/10.1002/anie.200904538>.
- [6] Why Guardian Polymer - CCL Secure. Available online: <https://cclsecure.com/guardian/why-guardian-polymer/> (accessed Sep 27, 2022).
- [7] Spartan - CCL Secure. Available online: <https://cclsecure.com/spartan/> (accessed Sep 27, 2022).
- [8] Safeguard Feature - Currency - De La Rue. Available online: <https://www.delarue.com/currency/products/safeguard-features> (accessed Sep 27, 2022).
- [9] Elleboudy, A. A. F.; Elagoz, M. A.; Simonian, G. N.; Hasanin, M. S. Biological Factors Affecting the Durability, Usability and Chemical Composition of Paper Banknotes in Global Circulation. *Egypt J Chem*, 2021, 64 (5), 2337-2342.
- [10] Luján-Ornelas, C.; Mancebo del C. Sternenfels, U.; Güereca, L. P. Life Cycle Assessment of Mexican Polymer and High-Durability Cotton Paper Banknotes. *Sci. Total Environ.* 2018, 630, 409-421.
- [11] Menzies, G. Money to Burn, or Melt? A Cost-Benefit Analysis of Australian Polymer Banknotes. *N. Am. J. Econ. Financ.* 2004, 15(3), 355-368.
- [12] Bandyopadhyay, T. POLYMER NOTES: What's That? | LinkedIn. Available online: <https://www.linkedin.com/pulse/polymer-notes-whats-tamal-bandyopadhyay/> (accessed Aug 26, 2022).
- [13] VSC8000/HS | Foster + Freeman <https://fosterfreeman.com/vsc8000-hs/> (accessed Aug 23, 2022).
- [14] Dahanukar, R. MONEY TALKS: “Back to the Future” — Challenges in Banknote Design. In *Design for Tomorrow — Proceedings of ICoRD 2021 (Smart Innovation, Systems and Technologies, Vol. 221)*; Chakrabarti, A.; Poovaiah, R.; Bokil, P.; Kant, V., Eds.; Springer: Singapore, 2021; pp. 191–201.
- [15] Carney, M. Opening Remarks at the £10 Note Launch; Bank of England, 2017. Available online at www.bankofengland.co.uk/speeches.
- [16] Adams, R.; Warner, R. Introduction to Security Printing; Printing Industries Press, 2016.
- [17] Bozhkova, T.; Spiridonov, I.; Shterev, K. Overview of Security Printing Types and Trends in Its Future Development. *Bulgarian Chemical Communications*, 2017, 49, 195–201.
- [18] Solomon, D.; Spurling, T. The Plastic Banknote: From Concept to Reality; CSIRO Publishing, 2014.
- [19] Media Center – De La Rue <https://www.delarue.com/media-center> (accessed Sep 27, 2022).
- [20] Van der Horst, F.; Snell, J.; Theeuwes, J. Finding Counterfeited Banknotes: The Roles of Vision and Touch. *Cogn. Res.: Princ. Implic.* 2020, 5 (1) 40.
- [21] Chahal PK, Kaur J, Singh P. Digital watermarking on bank note. *Int. J. Soft Comput. (IJSCE)*. 2014, 3(6), 38-41.
- [22] Kumar, P.; Bhandari, D.; Sharma, P.; Kaur, N.; Khandekar, H.; Chouhan, J. S.; Sahajpal, V. Comparative Analysis of Security Features in Banknotes Across Various Global Economies Using VSC®-8000/HS. *Int. J. Multidiscip. Res.* 2023, 5 (5), 1-38.
- [23] Rafiei, A.; Karimi, A.; Bodaghi, M. Polymer Banknotes: A Review of Materials, Design, and Printing. *Sustainability* 2023, 15(4), 3736.