RESEARCH ARTICLE

Fake Product Detection Using Diverse Technologies

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Abstract – The development of a new products always comes with the risk of Counterfeiting. Hence, it becomes really important to control the flow of these products as it directly affects companies revenue and goodwill and may also affect the consumer. In this paper, We Analysed about various technologies like RFID tags, Cryptography, Artificial Intelligence (AI), Blockchain and NFTs, that are used to detect the fake products how each technology works, it's advantages and limitations by which customer can get some clarity to choose the Counterfeiting technology as per to their requirements.

Index Terms – RFID tags, Cryptography, AI, Blockchain, NFTs.

I.   INTRODUCTION

In this paper we discuss about various technologies which are used in Fake product detection and they are

Counterfeit

Counterfeit refers to a fake or imitation product that is made to look like a genuine product. Counterfeiting is the act of producing and distributing these fake products, often with the intention of deceiving consumers into believing they are purchasing a genuine product. Counterfeiting is a form of fraud that can have serious consequences for both businesses and consumers, including financial losses and health risks.

RFID Tags

RFID (Radio-Frequency Identification) tags are small electronic devices that use radio waves to transmit data wirelessly. They consist of a microchip that stores data and an antenna that receives and transmits signals. RFID tags can be attached to products, packaging, or equipment, allowing them to be tracked.

Cryptography

Cryptography is the practice of making information unreadable by anyone except those who are authorized to read it. It involves using mathematical algorithms to convert plain text into coded or scrambled text, and then back again to plain text. This helps to ensure the confidentiality, integrity, and authenticity of information.

Artificial Intelligence

Artificial Intelligence (AI) refers to the ability of machines to perform tasks that would typically require human intelligence, such as recognizing speech, making decisions, or translating languages, by using algorithms and statistical models to analyze and learn from data.

Blockchain

Blockchain technology is the distributed, decentralized, and digital ledger that stores transactional information in the form of blocks in many databases which is connected with the chains. Blockchain technology is secure technology therefore any block cannot be changed or hacked. By using Blockchain technology, customers or users do not need to rely on third-party users for confirmation of product safety.

NFTs

NFTs, or Non-Fungible Tokens, are unique digital assets that are stored on a blockchain. Unlike cryptocurrencies like Bitcoin, which are fungible and can be exchanged for other cryptocurrencies of equal value, each NFT is unique and cannot be exchanged for something else. NFTs can represent a wide range of digital and physical assets, including art, music, videos, and even physical products. They provide a way for creators to prove ownership and authenticity of their digital creations, and for collectors to verify the rarity and uniqueness of their digital assets.

II.   LITERATURE SURVEY

Aadeesh Bali has proposed a system to prevent fake products from being sold. The system uses QR codes to verify the authenticity of the product and stores the product's supply chain history and ownership information. To ensure that the stored data is secure and cannot be tampered with, the system uses blockchain technology. By using this system, customers can verify the product's authenticity before purchasing it [1]. **Cheman Shaik** proposed a new way to stop fake products from being sold by using cryptography, QR codes, and a webservice. To use this method, every original product manufacturer needs to create a secure key and put a QR code of the key on their website. They also need to put a QR code inside each product pack that contains a code encrypted with their private key. Buyers can then use a QR code scanning app provided by the manufacturer to verify the product's authenticity. This way, buyers can ensure they are getting the real product, and not a fake one [3].

Eduard Daoud has created a web-based system that uses deep learning to identify fake products. The system works by analysing the certifications and quality marks of products that are suspected to be fake. The process involves two steps: building a web application and creating a deep learning model using the concepts of classification and localization. The deep learning model uses feature extraction and object detection to identify fake products. The web application uses Google Tensor flow and a web server to run the system [4]. **Martin Gaedke** proposed a cheap and easy-to-use solution that relies on machine learning to help consumers identify and verify products. This system uses image and text recognition to improve fake product detection, and it can be combined with other technologies like over, covert, and/or track and trace to make counterfeit detection more efficient and effective. Overall, this solution aims to make it easier for consumers to identify fake products without needing any special equipment [4].

Pim Tuyls proposed using RFID tags for anti-counterfeiting purposes. The RFID tag would contain specific product and reference information to verify the authenticity of the product. A reader would check if the necessary and authentic information is present on the tag when the product passes by. This application of RFID goes beyond identification and aims to prevent counterfeiting [9]. **Rashmi Tundalwar** suggested a system to detect fake products. The system involves creating a QR code for each product that contains its information and storing it in a blockchain database. When a customer or distributor buys a product, they scan the QR code embedded in the product. If the scanned QR code matches the stored QR code, the system considers the product genuine. If it doesn't match, the system considers the product to be fake. This system helps to prevent the sale of fake products [10].

III. HISTORY OF INTRODUCING TECHNOLOGIES FOR FAKE PRODUCT DETECTION

Fake product detection has been a concern for centuries, and various technologies have been used over time to combat this problem. Here is a brief history of some of the key technologies used in fake product detection: **Watermarks:** Watermarks were one of the earliest technologies used to detect counterfeit currency. In the late 17th century, the Bank of England began to use watermarked paper to produce banknotes. The watermarks, which were created by impressing a design into the paper, made it more difficult to counterfeit banknotes. **Holograms:** Holograms have been used since the 1970s to authenticate products, such as credit cards and passports. Holograms are a type of image that is produced using lasers, and they can be difficult to reproduce accurately, making them a popular security feature.
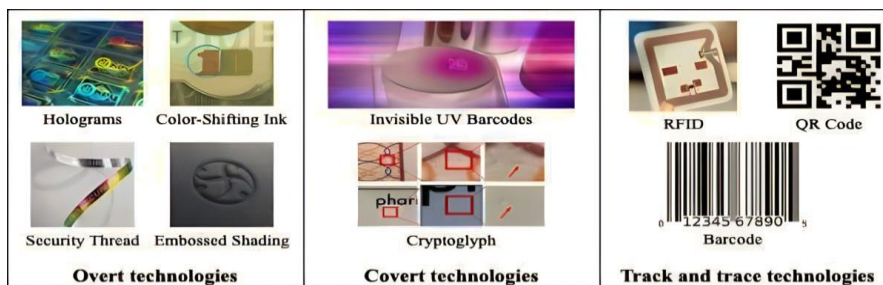

Fig 1: Counterfeit Technologies

Real   Fake

Fig 2: Watermarks

Barcodes: Barcodes were invented in the 1970s and have been used to track and authenticate products ever since. Barcodes are a series of lines and spaces that can be read by a scanner, and they can be used to store information about a product, such as its price and origin. **RFID:** RFID technology was first developed in the 1940s, but it wasn't until the 1990s that it began to be used widely in product tracking and authentication. RFID tags are attached to products and contain a microchip that can be read by a scanner, making it possible to track the product's journey through the supply chain.

Artificial Intelligence: AI is a relatively new technology that has quickly become a powerful tool in fake product detection. AI can analyze large amounts of data and identify patterns and anomalies that may indicate the presence of fake products. For example, AI can analyze images of products to detect subtle differences between genuine and fake products, or it can analyze transaction data to identify suspicious activity. **Blockchain:** Blockchain technology was invented in 2008 as the underlying technology for the cryptocurrency Bitcoin. However, it has since been used in a variety of other applications, including product tracking and authentication. Blockchain can be used to create a secure, transparent record of a product's journey from production to sale, making it more difficult to counterfeit or tamper with the product.
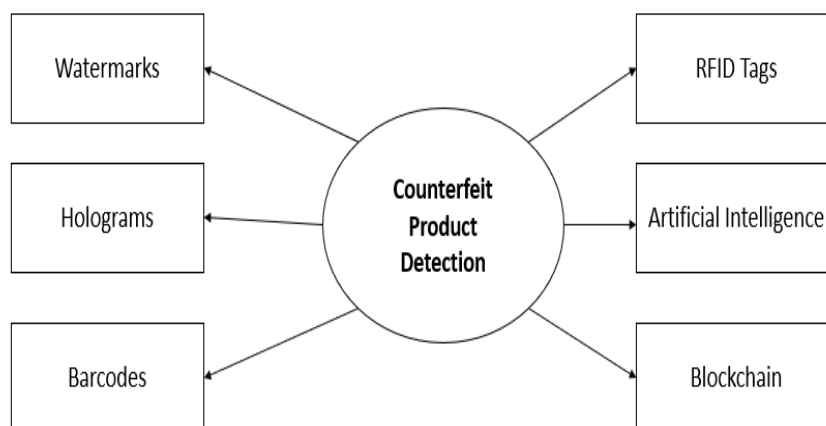

Fig 3: Fake Product Detection Technologies

Overall, as the problem of fake products has evolved over time, so have the technologies used to combat it. From watermarks to blockchain, each technology has played a crucial role in the ongoing fight against counterfeit products.

IV.   WORKING OF DIFFERENT TECHNOLOGIES IN FAKE PRODUCT DETECTION

RFID TAGS

RFID (Radio Frequency Identification) tags work by using radio waves to communicate information between the tag and a reader device. In the context of fake product detection, RFID tags can be used to authenticate products and identify counterfeits. Each RFID tag contains a microchip and an antenna. The microchip contains a unique identifier code that is associated with the product it is attached to. When the tag comes within range of an RFID reader, the reader sends out a radio signal that is received by the tag's antenna. The tag uses the energy from the radio signal to power the microchip, which then sends back its unique code to the reader.

In the case of fake product detection, authentic products are tagged with RFID tags during the manufacturing process. When the products are sold, retailers can use RFID readers to verify the authenticity of the products. If a product does not have a valid RFID tag or if the tag's code does not match the expected code for that product, it may be a counterfeit. RFID technology can also be used to track products throughout the supply chain, making it possible to identify where a counterfeit product entered the supply chain and take steps to prevent further distribution.
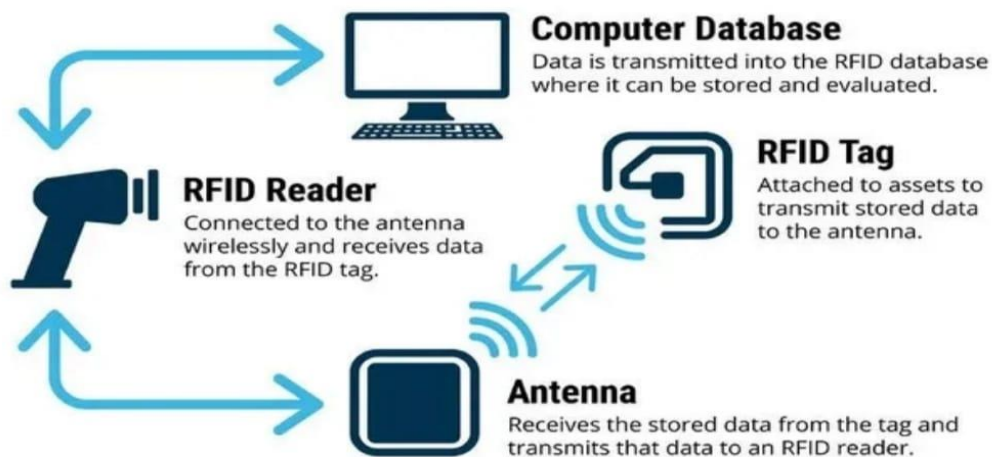

Fig 4: Working of RFID Tags

CRYPTOGRAPHY

Cryptography is used to create secure product authentication codes or labels, such as holograms or QR codes, that are placed on products. These codes or labels are generated using a cryptographic algorithm that produces a unique code for each product, which can be verified by authorized parties

using a secret key or password. To detect fake products, authorized parties can scan the authentication code or label using a specialized app or device that can decode the encrypted information. If the code or label is authentic, the app or device will verify the product as genuine. If the code or label is fake, the app or device will flag the product as a counterfeit.
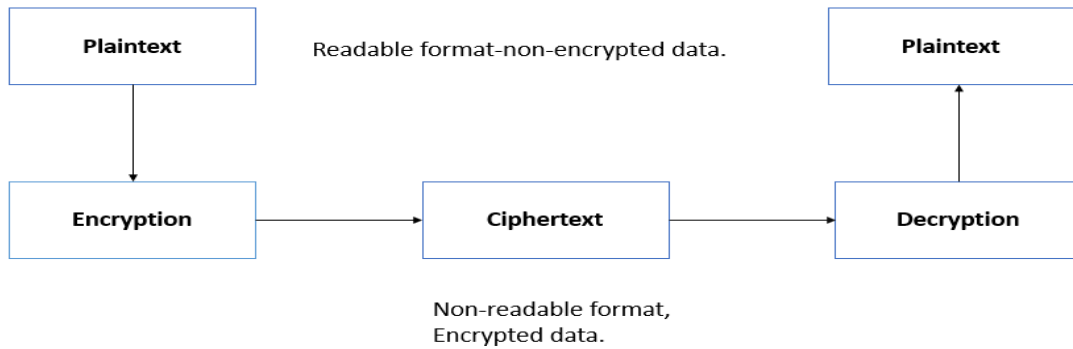
Fig 5: Basic cryptography

Artificial Intelligence

Artificial Intelligence (AI) can be used in fake product detection in a variety of ways, including image recognition, natural language processing, and predictive analytics. Here are a few examples of how AI can be used in this context:

Image recognition: AI-powered image recognition can be used to identify counterfeit products based on their appearance. For example, a retailer could use AI to analyze product images and identify subtle differences between genuine and counterfeit products. The AI algorithm could be trained to detect specific features, such as variations in color or texture, that indicate that a product is not genuine.

Natural language processing: AI can be used to analyze product descriptions, customer reviews, and other text-based data to identify patterns that may indicate counterfeit activity. For example, an AI algorithm could be trained to identify keywords and phrases commonly used in counterfeit product listings, such as "replica" or "fake."

Predictive analytics: AI can be used to analyze data from multiple sources, including sales data, supply chain data, and customer data, to identify patterns and predict future trends. This can help retailers and manufacturers to identify potential counterfeit activity before it becomes a problem.

Fraud detection: AI-powered fraud detection algorithms can be used to analyze transaction data and identify patterns of suspicious activity. For example, an algorithm could be trained to identify orders that are unusually large, orders that are being shipped to unusual locations, or orders that are being placed with stolen credit card information.

Overall, AI has the potential to be a powerful tool in the fight against counterfeit products. By analyzing large amounts of data and identifying patterns and anomalies, AI algorithms can help retailers and manufacturers to identify and prevent counterfeit activity before it causes harm to consumers or their brand reputation.
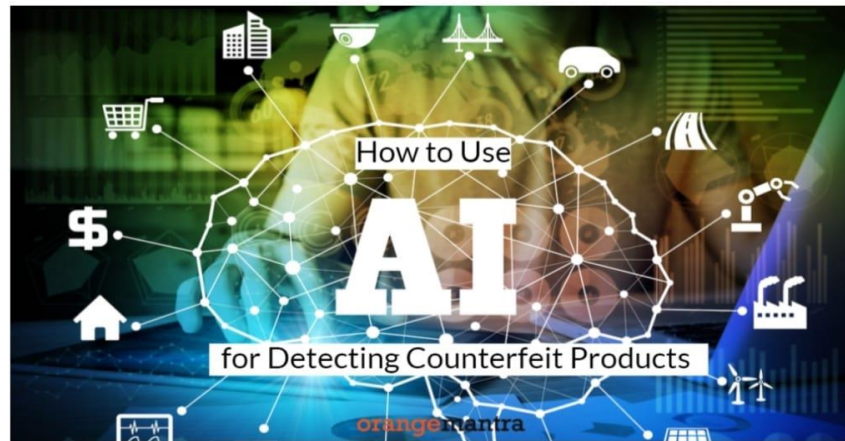

Fig 6: Use of Artificial Intelligence

Blockchain

Blockchain is a decentralized, distributed ledger technology that can be used to ensure the authenticity and traceability of products. In the context of fake product detection, blockchain can be used to create an immutable record of a product's journey from production to sale, making it much more difficult to counterfeit or tamper with the product. **Product traceability** Blockchain can be used to create a secure, transparent record of a product's journey from production to sale. Each step of the process, from the manufacturing facility to the retailer, can be recorded on the blockchain, creating an unbroken chain of custody. This can help to prevent counterfeiting by ensuring that the product is authentic and has not been tampered with.

Product authentication Blockchain can be used to create a unique identifier for each product, which can be recorded on the blockchain. This identifier can be used to verify the authenticity of the product throughout its lifecycle. For example, a retailer could scan the product's identifier using a smartphone app to confirm that it is genuine. **Supply chain transparency** Blockchain can be used to create a transparent record of the product's journey through the supply chain. This can help to prevent counterfeiting by allowing retailers and manufacturers to identify any anomalies or suspicious activity in the supply chain. For example, if a product suddenly appears in the supply chain without a clear origin, it could be a sign that it is counterfeit.

Consumer protection Blockchain can be used to provide consumers with a secure, verifiable record of their purchases. This can help to prevent counterfeiting by allowing consumers to confirm that the product they purchased is genuine. For example, a consumer could scan the product's identifier

using a smartphone app to confirm that it matches the record on the blockchain. Overall, blockchain has the potential to be a powerful tool in the fight against counterfeit products. By creating a secure, transparent reco-rd of a product's journey from production to sale, blockchain can help to prevent counterfeiting and protect consumers.
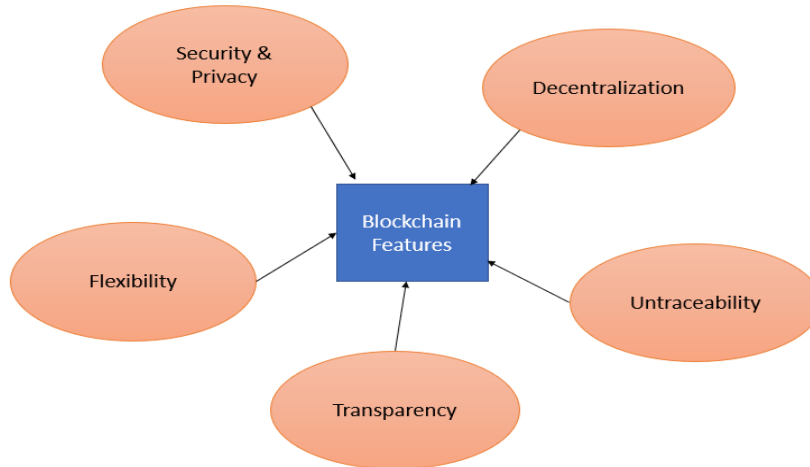
Fig 7: Blockchain Features

NFTs

NFTs are unique digital assets that can be used to represent physical objects or digital content. By creating an NFT for a product, a unique digital signature can be added to it. When someone buys the product, they can verify the authenticity of the NFT and therefore the product.
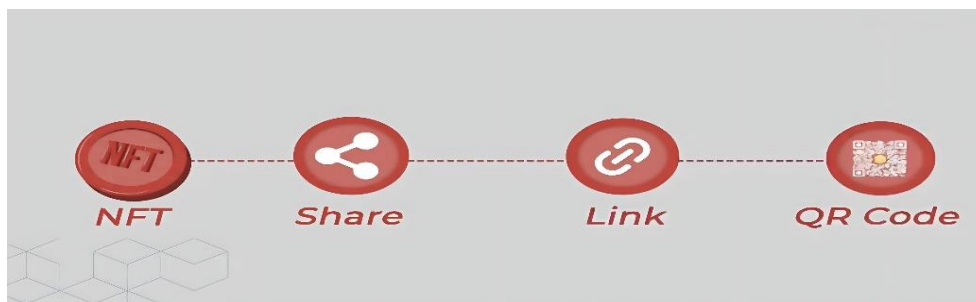
Fig 8: Non Functionable Tokens

Overall, while NFTs have the potential to be a useful tool in detecting fake products, they also have their limitations and drawbacks. Businesses considering using NFTs for this purpose should carefully evaluate the costs and benefits and consider whether it makes sense for their particular industry and products.

V. CONCLUSION

There are various technologies that can be used for fake product detection, each with its own advantages and limitations. Some technologies, such as hologram labels and RFID tags, have been around for a while and have proven to be effective in certain industries. Others, such as blockchain and NFTs, are newer technologies that have shown promise in providing secure and reliable ways to verify product authenticity. However, no single technology can solve the problem of fake products alone. A combination of technologies and strategies is often required to effectively detect and prevent fake products from entering the market. In addition, educating consumers about how to identify and verify authentic products is also crucial in the fight against counterfeit products. While technology can be a powerful tool in fake product detection, it is important to carefully evaluate the benefits and limitations of each technology and implement a comprehensive strategy that takes into account the specific needs of the industry and product.

REFERENCES

1. Bali, A., Singh, A., & Gupta, S. Fake Product Detection System Using Blockchain.
2. Pathak, A., Velasco, C., & Calvert, G. A. (2019). Identifying counterfeit brand logos: On the importance of the first and last letters of a logotype. *European Journal of Marketing*, *53*(10), 2109-2125.
3. Shaik, C. (2021). Preventing counterfeit products using cryptography, qr code and webservice. *Computer Science & Engineering: An International Journal (CSEIJ)*, *11*(1).
4. Daoud, E., Vu, D., Nguyen, H., & Gaedke, M. (2020). Improving fake product detection using ai-based technology. In *Proceedings of the 18th International Conference on E-Society (ES 2020)*.
5. Nguyen, H. P., Retraint, F., Morain-Nicolier, F., & Delahaies, A. (2019). A watermarking technique to secure printed matrix barcode—Application for anti-counterfeit packaging. *IEEE Access*, *7*, 131839-131850.
6. Babu, H. U., Stork, W., & Rauhe, H. (2010, December). Anti-counterfeiting using reflective micro structures-Based on random positioning of microstructures. In *Advances in Optoelectronics and micro/nano-optics* (pp. 1-5). IEEE.
7. Jadhav, R., Shaikh, A., Jawale, M. A., Pawar, A. B., & William, P. (2022, June). System for Identifying Fake Product using Blockchain Technology. In *2022 7th International Conference on Communication and Electronics Systems (ICCES)* (pp. 851-854). IEEE.
8. Ahmed, S. T., Sandhya, M., & Sankar, S. (2019). An optimized RTSRV machine learning algorithm for biomedical signal transmission and regeneration for telemedicine environment. *Procedia Computer Science*, *152*, 140-149.
9. Agrawal, N., Kushwaha, H., Shetty, S., & Lobo, V. B. (2022, June). A System to Detect Fake Products using Blockchain Technology. In *2022 7th International Conference on Communication and Electronics Systems (ICCES)* (pp. 874-878). IEEE.

10. Singh, K. D., & Ahmed, S. T. (2020, July). Systematic Linear Word String Recognition and Evaluation Technique. In *2020 International Conference on Communication and Signal Processing (ICCSP)* (pp. 0545-0548). IEEE.

11. Tuyls, P., & Batina, L. (2006). RFID-tags for anti-counterfeiting. In *Topics in Cryptology–CT-RSA 2006: The Cryptographers' Track at the RSA Conference 2006, San Jose, CA, USA, February 13-17, 2005. Proceedings* (pp. 115-131). Springer Berlin Heidelberg.

12. Syed Thouheed Ahmed, Adarsha V S, B Vikas, Prommoth V M, & Punithan P. (2023). Detection of Inauthentic Accounts on Twitter. *International Journal of Human Computations & Intelligence*, *2*(4), 176–183. https://doi.org/10.5281/zenodo.8026926

13. Zhao, Z. Q., Zheng, P., Xu, S. T., & Wu, X. (2019). Object detection with deep learning: A review. *IEEE transactions on neural networks and learning systems*, *30*(11), 3212-3232.