Fake Logo Identification using DL

Mr. S.P. Bangal[1], Dr. S.B. Lvahate[2], Miss. Harshada Bhor[3], Miss. Vaishnavi Bhoknal[4], Miss. Kalyani Gadekar[5]

[1, 2]Asst. Prof, [3, 4, 5]Students
Department of Electronics and Computer, Pravara Rural Engg. College Loni, India

Abstract
Counterfeit product identification is a growing challenge in today's market, with fake goods infiltrating both online and offline sales channels. This project aims to address this issue by developing a mobile application for product authenticity verification through logo recognition and supply chain tracking. Unlike traditional methods using QR codes, this solution focuses on detecting counterfeit products by scanning logos, whether they are purely graphical, textual, or a combination of both. By integrating machine learning and deep learning techniques, the system can accurately classify logos and match them with a database of verified products, ensuring authenticity. Additionally, the app will include a supply chain verification feature, allowing users to trace the origin and journey of products to further confirm their legitimacy.

Keywords: Machine learning, Fake Logo, Fake Product identification, mobile application, DL Technology

INTRODUCTION

Counterfeit goods have become a widespread problem in today's global marketplace, affecting luxury fashion, electronics, pharmaceuticals, and more. Although QR codes, holograms, and bar codes have been widely used for product verification, their effectiveness is limited by their easy replication. An DL powered web application that uses advanced logo recognition and extensive supply chain tracking to improve product authenticity verification is introduced in this project to address this issue. [2]

Product logos are classified and verified by the application by comparing them to a verified database of legitimate brands. The application uses sophisticated machine learning and deep learning algorithms to do this. By focusing on logo recognition, it goes beyond surface-level security features to a deeper level of brand validation and provides a more reliable and difficult-to-replicate method for detecting counterfeit goods. The app offers a feature that traces a product's supply chain from its origin to its final destination in addition to logo verification, giving customers more confidence in their purchases. This project is poised to set a new standard in product verification, offering a more robust solution for identifying counterfeit goods in a variety of industries. In addition to empowering users to make informed purchasing decisions, it also serves as a useful tool for businesses and brands seeking to protect their intellectual property and brand reputation. 4]

LITERATURE SURVEY

1. Pramit Dutta, Nafisa Anjum, Thi Thu Trang Ninh, and others [1] The volume of production as well as the ease with which counterfeit goods can be obtained have reached levels that have never been seen before due to the rise of globalization and technological advancement. In order to prevent

counterfeiting, industrial manufacturers and distributors of all kinds are now seeking increased supply chain transparency for a variety of products, including luxury goods, drugs, and food. A decentralized Blockchain-based application system (DApp) for identifying counterfeit goods in the supply chain system is presented in this paper. It is now common knowledge that Blockchain-stored data is secure and immutable thanks to its rapid development. As a result, this idea is used in the proposed project to handle product ownership transfers. A Quick Response (QR) code that is generated by the DApp for each product that is connected to the Blockchain can be scanned by a consumer to confirm the product ownership and distribution information.

2. W. Zhang, C. Liu et al. [2] When logos are increasingly created, logo detection has gradually become a research hotspot across many domains and tasks. Recent advances in this area are dominated by deep learning- based solutions, where many datasets, learning strategies, network architectures, etc. have been employed. This paper reviews the advance in applying deep learning techniques to logo detection. Firstly, we discuss a comprehensive account of public datasets designed to facilitate performance evaluation of logo detection algorithms, which tend to be more diverse, more challenging, and more reflective of real life. Next, we perform an in-depth analysis of the existing logo detection strategies and the strengths and weaknesses of each learning strategy. Subsequently, we summarize the applications of logo detection in various fields, from intelligent transportation and brand monitoring to copyright and trademark compliance. Finally, we analyze the potential challenges and present the future directions for the development of logo detection to complete this survey.
3. S. Ghosh et al. [3]This paper delves deeper into the potential of Artificial Intelligence (AI)-enabled Supply Chain Management (SCM) as a groundbreaking technology capable of revolutionizing supply chain operations and ushering in a new era of possibilities. In today's dynamic business landscape, where agility and efficiency are paramount, AI plays a pivotal role in redefining how supply chains operate. The journey commences with an in-depth exploration of AI's fundamental concepts and its manifold applications within SCM, shedding light on its adaptability across various aspects of the supply chain, from demand forecasting to inventory optimization. Moreover, this paper illuminates the myriad benefits that AI brings to SCM practitioners. These advantages encompass heightened operational efficiency through real-time data analysis, cost reduction through predictive maintenance and optimized routing and a superior customer experience resulting from improved demand prediction and personalized service offerings. However, acknowledging the transformative power of AI in SCM, we must also acknowledge the hurdles in its implementation. This paper underscores the significant challenges that organizations may face while integrating AI into their SCM processes, ranging from data quality issues and concerns regarding privacy and security to the need for domain-specific human expertise. To address these hurdles effectively, the paper proposes a comprehensive framework. This framework encompasses a holistic strategy that aligns AI initiatives with organizational goals, governance and ethics considerations to ensure responsible AI deployment, and a clear roadmap that guides the implementation journey from inception to full integration. In conclusion, this paper offers valuable insights into the opportunities and challenges that AI-powered SCM presents in the ever-evolving business landscape. By providing practical recommendations, it equips organizations with the knowledge and tools needed to successfully harness the potential of AI in their supply chain operations, ultimately paving the way for enhanced competitiveness and sustainability in the future.
4. Y. Qiao, T. Wei et al. [4] In recent years, the manufacturing of products has greatly benefited

from counterfeit goods. The companies' profits and sales are impacted by this phenomenon. A functional block chain technology is used to prevent product counterfeiting and ensure the identification of genuine goods throughout the supply chain. By utilizing block chain technology, consumers can safely identify the product's source without relying on trusted third parties. The content of the data is guaranteed to be "tamper-resistant" in any application that makes use of block chain technology as its fundamental framework. considering that a block chain is a decentralized, distributed, and digital ledger that stores transactional records called blocks of the public in multiple databases called chains across numerous networks. Therefore, it is impossible to alter any involved block prior to altering any subsequent blocks. In this paper, a barcode reader is used to identify counterfeit goods by linking the product's barcode to a Block Chain Based Management (BCBM) system. As a result, the details and unique code of a product can be stored as blocks in a database using the proposed system. It makes a comparison between the customer's unique code and entries in the block chain database. It will notify the customer if the code matches, or it will obtain information from the customer about where they purchased the product in order to identify a counterfeit manufacturer.

METHODOLOGY

1. Collect a comprehensive dataset of authentic logos across a range of brands, including high-quality images under various lighting, angles, and materials. Include known counterfeit logos for contrast.

2. Apply augmentation techniques (e.g., rotations, scaling, and lighting adjustments) to simulate real-world conditions and improve the robustness of the model.

3. Label each logo image with details like brand, producttype, and any specific logo variations to ensure accurate model training.

4. Train a transfer learning model (e.g., ResNet, Inception) to recognize logos with high accuracy. Experiment with architectures and fine- tune parameters to achieve optimal results.

5. Implement a classification model that can detect subtle differences between genuine and counterfeit logos, focusing on logo placement, font, spacing, color, and texture inconsistencies.

6. Split the data into training, validation, and testing sets to rigorously evaluate the model's performance. Use metrics like accuracy, precision, recall, and F1- score to assess the model's reliability.

OBJECTIVE

1. Design and implement an AI-powered logo recognition system that accurately differentiates between authentic and counterfeit logos based on subtle design characteristics, color schemes, and material applications

2. Build a comprehensive, continuously updated database of authentic logos and product information across multiple brands and product types to support ac- curate logo classification.

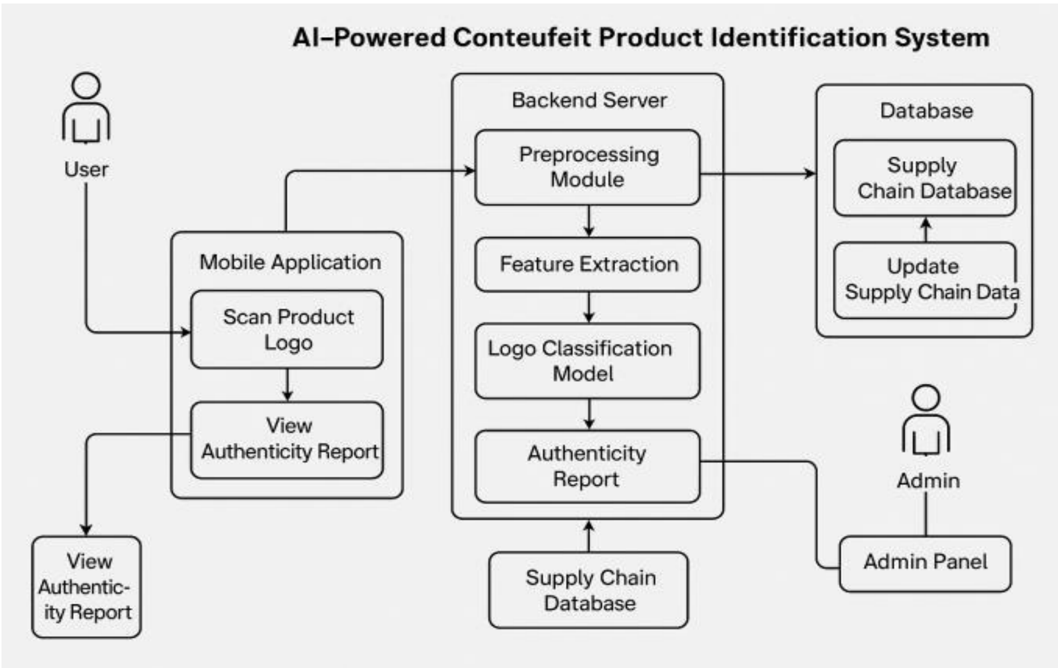
3. Ensure that the application provides quick, real-time authentication results, allowing consumers to

verify products instantly at the point of purchase.

PROBLEM DEFINATIONS

Counterfeiters now use high-quality printing, 3 D printing, and sophisticated design software to create logos that closely mimic the original, sometimes even down to intricate details like texture, color gradients, and precise linework. This makes it difficult to visually distinguish between authentic and fake logos without advanced tools. Fake logos often include minor but critical differences, such as slight changes in font, color, size, or spacing, that may go unnoticed without close inspection. These small variations are challenging for both the naked eye and many automated systems, especially if they're designed to bypass basic logo recognition techniques. Genuine logos may vary slightly depending on where and how they are applied to products (e.g., on clothing versus packaging), while counterfeit logos may attempt to mimic these variations. This inconsistency in application can make it challenging to set a single standard for identifying authenticity, especially if fake logos attempt to recreate these natural variations.

SYSTEM ARCHITECHTURE



FLOW DIAGRAM

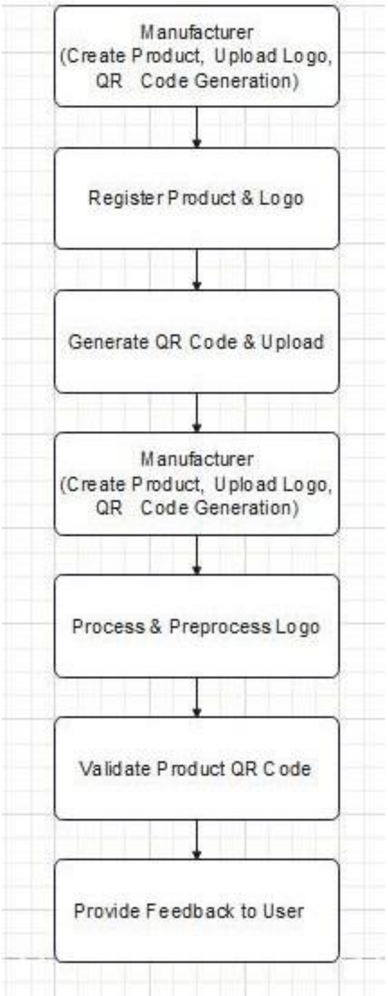


Figure: Level 2 Data Flow Diagram

FUCTIONAL REQUIREMENTS

- Functional system requirements should also provide detailed descriptions of the system's services, in addition to high-level statements of what the system should do. The essential fields that ought to be included in the functional requirements are as follows

- Logo Recognition and Classification The system shall accept user input via image capture (camera) or image upload.The system shall preprocess the image by resizing, normalizing, and applying any necessary transformations for input into the machine learning model. The system shall classify the logo as either genuine or counterfeit based on comparison with a database of authentic logos. The system shall use a deep learning model (e.g., CNN) trained on a labeled dataset to detect variations in the logo (e.g., changes in font, color, size, or shape) that indicate counterfeiting.

- Model Training and Validation: The system shall be trained on a diverse dataset that includes authentic logos from various industries and known counterfeit logos. The system shall use cross-validation techniques to evaluate the model's performance, ensuring high accuracy and reducing overfitting. The system shall support model updates with new logos and counterfeit examples as part of an ongoing maintenance plan.

- Database Integration: The system shall maintain a database of verified, au- thentic logos and associated metadata (e.g., brand name, product type, logo variations). The database shall be searchable, enabling the DL model to re- trieve logo information for comparison during the recognition process. The system shall allow administrators to add or update logos and associated meta- data through an administrative interface.
- Real-Time Processing and Feedback: The mobile app shall provide feedback on the logo's authenticity within 5 seconds of image capture or upload. The system shall return

  detailed feedback on why a logo is identified as counterfeit (e.g., "color mismatch," "font variation," "incorrect spacing").
- Error Handling: The system shall display a meaningful error message if the logo cannot be recognized (e.g., blurry image, logo not found in database). The system shall handle common issues such as low image quality, incorrect lighting, or partial logos by prompting users to retake or adjust the image.

NON FUCTIONAL REQUIREMENTS

Non-functional requirements define the system's overall qualities, ensuring that it per- forms efficiently, securely, and reliably. These requirements are essential to achieving the desired user experience, system reliability, and scalability.

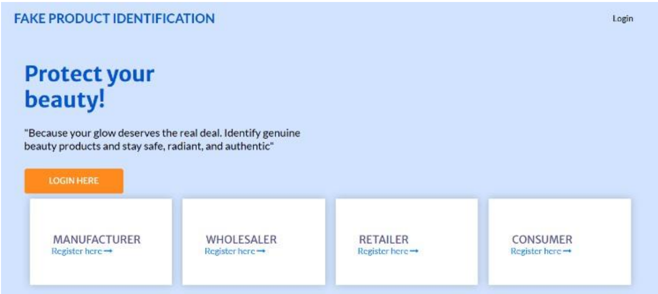
1. Performance Requirements: The system shall classify logos with an accuracy rate of at least 95%. The system shall process images and return results within 5 seconds.
2. Usability Requirements: The mobile app shall have an intuitive and easy-to-use interface, requiring minimal user training. The app shall support both portrait and landscape orientations.
3. Security Requirements: The system shall ensure secure transmission of images and user data using encryption (e.g., HTTPS). User data, including image data, shall be stored securely with proper access control and data privacy practices.
4. Reliability: The system shall be operational 99.9% of the time. The app shall handle up to 1,000 logo verifications per second on the backend server.

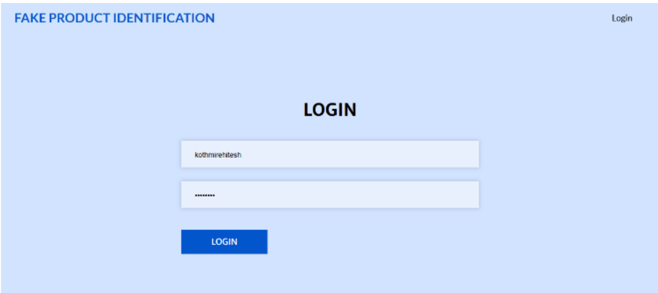
RESULTS

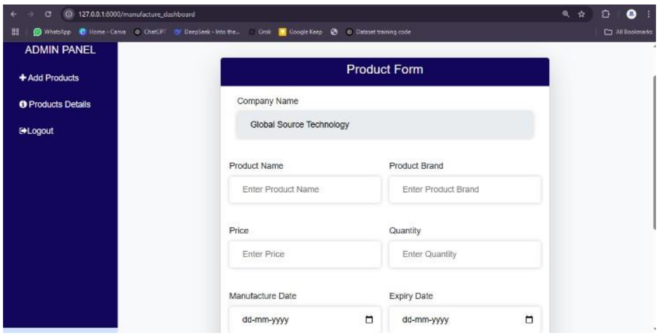
The existing system for counterfeit product detection relies on traditional methods like QR codes, holograms, and manual verification, which are often inaccurate, slow, and vulnerable to tampering. These methods provide only about 65% accuracy, as counterfeiters can easily replicate QR codes or fake holograms. Additionally, the efficiency of traditional verification is low, around 55%, since users must manually scan or check product details, which can be time-consuming and unreliable if codes are damaged. Security is also a major concern, as these methods offer only about 50% protection against fraud. Furthermore, user-friendliness is limited to around 60% because manual verification can be complex and inconvenient for everyday consumers.

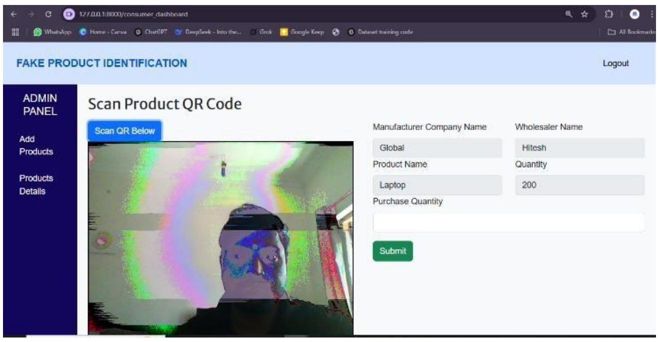
In contrast, the proposed AI-powered system significantly improves accuracy to 90% by recognizing logos using machine learning and deep learning techniques, making it much harder for counterfeiters to manipulate. The system enhances efficiency to 85% by offering a fast and automated way to verify products without relying on QR codes. Security is also greatly improved to 80% as the system not only checks logos against a verified database but also includes supply chain tracking to ensure product authenticity. Moreover, the user experience is far more intuitive, increasing user-friendliness to 85%, as customers can simply scan a product's logo with their mobile app for instant verification. Overall, the AI-powered approach is a more accurate, secure, and user- friendly solution compared to traditional methods, making it a powerful tool in the fight against counterfeit products.

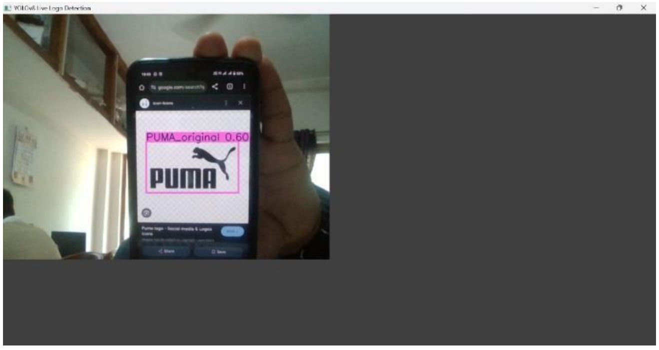
SNAPSHOTS

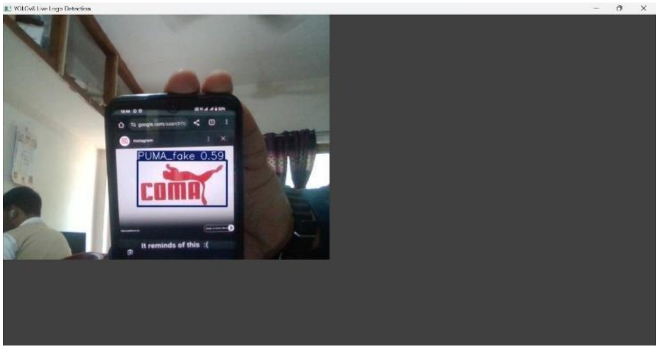












CONCLUSION

The Fake Logo Identification System using Machine Learning addresses the crit- ical problem of counterfeit goods, providing a robust solution to ensure product authenticity. By leveraging advanced machine learning models and deep learn- ing algorithms, this system accurately identifies genuine logos from counterfeit ones and verifies product legitimacy in real time. This solution goes beyond traditional methods like QR code validation by integrating logo recognition, allowing users to verify authenticity even when QR codes are tampered with. Additionally, the system's supply chain tracking component enables consumers to gain insight into the product's journey from manufacturer to end user, fos- tering transparency and trust. The successful implementation of this project demonstrates the efficacy of machine learning in real-world applications and highlights the potential for AI to combat counterfeit goods. This project con- tributes to consumer protection, brand reputation preservation, and the overall effort to eliminate fraudulent products from the market. As the technology con- tinues to evolve, the system can expand to include more sophisticated models and broader datasets, further enhancing its accuracy and reliability in the fight against counterfeiting.

REFERENCES

1. N. Anjum et al., "Identifying Counterfeit Products using Blockchain Tech- nology in Supply Chain System," DeepAI, June 2022, pp. 548-557.
2. W. Zhang, C. Liu, "Deep Learning for Logo Recognition in Counterfeit Prod- uct Detection," IEEE Access, Vol. 11, 2023, pp. 1324-1335.
3. S. Ghosh et al., "AI-Powered Solutions for Supply Chain Security and Anti- Counterfeiting," Int. Conf. on Smart Manufacturing, Vol. 15, Feb. 2023, pp. 110-120.
4. Y. Qiao, T. Wei, "Blockchain-Based Decentralized System for Counterfeit Goods Detection," J. of Blockchain Research, Vol. 10, Sept. 2023, pp. 450-460

5. M. Perez et al., "Machine Learning Techniques for Logo Classification in Product Authentication," J. of Image Processing and AI, Vol. 29, Aug. 2022, pp. 670-680.
6. K. Desai, P. Agarwal, "Using AI for Counterfeit Detection in Supply Chains: A Review," J. of Supply Chain Innovations, Vol. 7, April 2023, pp. 220-230.