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Identification of Fake Product by QR Code using Machine Learning

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ABSTRACT: In today's fast-paced consumer world, counterfeit products are a growing threat, impacting both customer safety and brand reputation. Fake items—from electronics to medicines—often look nearly identical to genuine ones, making it hard for the average consumer to spot the difference. This project aims to address that problem by introducing a smart, simple, and reliable system that uses QR codes and machine learning to verify product authenticity. The core idea is straightforward: each product is assigned a unique QR code linked to a trusted database. When scanned, the system checks the code against the machine learning model and database records. If it matches a genuine product entry, the product is confirmed as authentic; if not, it is flagged as potentially fake. This solution empowers customers to verify products instantly using just a smartphone or scanner. Developed using Python and Django, the system incorporates a QR scanner, user-friendly web interface, and a Pre-trained ML model that recognizes data patterns. SQLite is used as the backend database for storing product details securely. This approach also helps reduce but also gives organizations with a scalable way to fight counterfeiting without the necessity of expensive hardware or complicated setups. Overall, this work is a step forward in using modern technology to solve real-world problems. It blends simplicity, accuracy, and security into a solution that is usable by businesses, shopkeepers, and customers alike. By making product verification accessible and reliable, it helps protect both the market and the people in it.

KEYWORDS: QR Code, Counterfeit Prevention, SQLite Database, Consumer Protection.

I. INTRODUCTION

In today's modern marketplace, the growing problem of fake and counterfeit products has become a major issue affecting consumers and businesses. With the rise of e-commerce and global trade, counterfeiters now find it easier to copy genuine products and circulate them in the market. These fake items have damaging effects on the economy but may also be dangerous to the well-being of people—especially in industries like pharmaceuticals, electronics, and food products. Many consumers end up buying these counterfeit items without even realizing it, mainly because they often appear quite similar to the original ones. This creates a situation where trust is lost, and genuine manufacturers suffer huge losses. Addressing this issue requires a practical, accessible, and reliable method available for public use in their everyday lives.

That's where this project comes in. The idea behind "Identification of Fake Product by QR Code Using Machine Learning" is to make product verification easy and accurate by using basic tools that are currently available—QR codes, machine learning, and a web interface. Instead of expecting users to understand complex anti-counterfeiting features, this system allows them to simply scan a QR code printed on the product. Once scanned, the system checks the product information in a protected database with ML algorithms. If the data matches what's recorded in the system for a genuine item, the user gets a confirmation. If the QR code seems to have been messed with or doesn't match, the system flags it as suspicious or fake. This helps users easily know whether the item they're holding is real or counterfeit.

The project is built using Django, a powerful web framework in Python, which helps manage the backend processes like data storage and retrieval. It uses SQLite, a lightweight yet effective database system, to hold all the verified product information. For the machine learning component, a trained model is integrated to detect patterns within the collected information and improve the accuracy of the verification process. Using machine learning indicates that the system gets smarter over time. As it processes more data, it can identify newer patterns of fake products and improve its ability to detect fraud.

Another important strength of this system is its user-friendliness. It's structured allowing people with basic technical knowledge can use it. The web interface is clean and simple—users just upload or read the QR code and instantly get the result. This makes the system highly practical for use in real-world settings like retail shops, warehouses, and even at

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home by everyday consumers. For businesses, it gives a cost-effective and scalable solution which can be integrated into their product packaging without the need for expensive technology.

Moreover, this system is also a valuable tool for companies to track their products. Every time a QR code is scanned, it creates a log which can be used for auditing or tracking the flow of products across different regions. It also acts as a digital proof of authenticity, that is usable in disputes or customer claims. For customers, it gives peace of mind, knowing they are purchasing original, safe, and trusted items.

In a time when digital transformation is shaping every part of our lives, combining QR technology with machine learning offers an efficient way to tackle one of the greatest stubborn issues in retail and distribution. This project doesn't just highlight a technological solution—it presents a step toward creating a safer, Improved business environment with trust and consumers alike. By bringing together technology and practicality, this system is capable of make a meaningful difference in how people buy and sell products in the future.

This project — Identification of Fake Product by QR Code using Machine Learning — aims to build such an intelligent system. It's not just about reading a QR code; it's about making the product world safer, smarter, and more trustworthy for everyone — manufacturers, sellers, and everyday consumers like us.

II. LITERATURE SERVIEW

1. Securing QR Codes Infrastructure Using AI to Detect Malicious Activity AUTHOR: Luis Rivas; Varun Kumar Singh
YEAR: 2025
With the advent of QR Codes, mobile devices, and computers, users can exchange information quickly but not se-curely. QR Codes-based attacks are rising rapidly, threatening the trust of this extensively used technology. Whether you use it at a restaurant, conference, or payment station, QR Codes inherently rely on user trust to safeguard transactions.

2. Fake Product Detection Using Blockchain Technology AUTHOR: Sriman B; Nitesh Kumar L
YEAR: 2024
The increase in fake products poses an important challenge to manufacturers, affecting their company image, sales, and profitability. However, blockchain technology provides a solution by ensuring the detection and tracking of genuine product along the supply chain. Blockchain works like a shared digital record that safely keeps transactional data in interconnected databases.

3. Detection of Fake Products Using Blockchain AUTHOR: Swathi Y; A K N S Madhurima Gayathri YEAR: 2024
Manufacturing and selling of counterfeit items and goods endanger end consumers' financial, health, and safety. Additionally, it affects the financial expansion of authentic producers and companies due to lost revenue and brand defamation, system outage and replacement costs, the need for companies to spend finances fending off counterfeits, sales theft, etc.

4. An Experimental Evaluation of an Effective QR Code Based Duplicate Product Detection Using Blockchain Technology
AUTHOR: R. Geetha; Jayakumar D YEAR: 2024
Over the span of the last few years, innovations in blockchain technology have received a great deal of attention. Currency exchange, which has a variety of applications in addition to digital money, is the subject that receives the most attention. Because of this, it may have an effect on multiple industries.

5. Securing Authenticity: A Frontier Block Chain-Powered Fake Product Detection via QR Codes AUTHOR: Dileep M R; Sathvic A
YEAR: 2024
People and businesses are becoming more and more concerned about the increase in fake goods. The spread of fake goods poses a major risk to the financial stability and reputation of businesses, in addition to public health and safety. Blockchain offers a decentralized and secure platform that enables customers to track and confirm the genuineness of products and effectively distinguish and keep away from fake merchandise.

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III. SYSTEM MODEL AND ASSUMPTIONS

The system is designed to mimic a real-world scanning experience while handling back-end intelligence. Here are the foundational assumptions:

- Every product has a unique QR code that is pre-registered in the system by a trusted administrator.
- Users scan QR codes via a web application built using Django, capable of running on any internet-connected device.
- A machine learning model analyzes input features from the QR code scan—such as product ID, scan frequency, timestamp, and location anomalies—to determine authenticity.
- SQLite is used as the database for ease of setup and deployment in small to medium-sized organizations.
- Users are categorized into general users (who scan and view results) and admin users (who manage product data and monitor system logs).

IV. PROPOSED METHODOLOGY

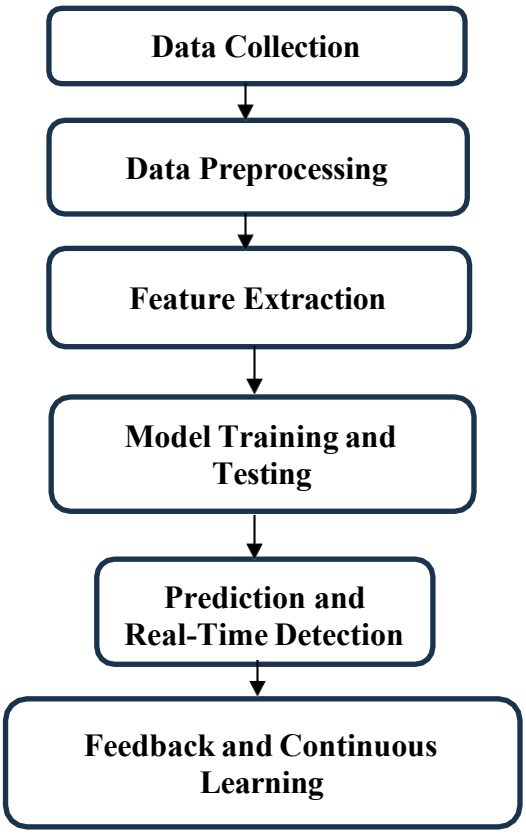

Fig-1: Methodology Diagram

The architecture consists of the following modules:

4.1 Data Collection: Authentic and counterfeit QR data are gathered, including metadata such as product name, manufacturing date, batch number, and serial codes.

4.2 Data Preprocessing: Datasets are cleaned and structured. Missing values are handled, redundant entries are removed, and strings are encoded for processing.

4.3 Feature Extraction: Critical attributes are selected to train the model. These include:

- QR scan time and frequency
- Consistency between batch and location data
- Pattern recognition of previously known counterfeit indicators

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4.4 Model Training: A Random Forest classifier is trained using labeled data. This model was chosen for its robustness and ease of interpretability.

4.5 Real-Time Prediction: On scanning a QR code, the system extracts data from the code and checks its validity in the database. It then feeds the extracted features into the ML model for a verdict: "Genuine" or "Fake".

4.6 Feedback Loop: When users manually report a result, or if new suspicious patterns are detected, the system logs these inputs. This helps in retraining and improving the model periodically.

V. SYSTEM ARCHITECTURE AND EFFICIENT COMMUNICATION

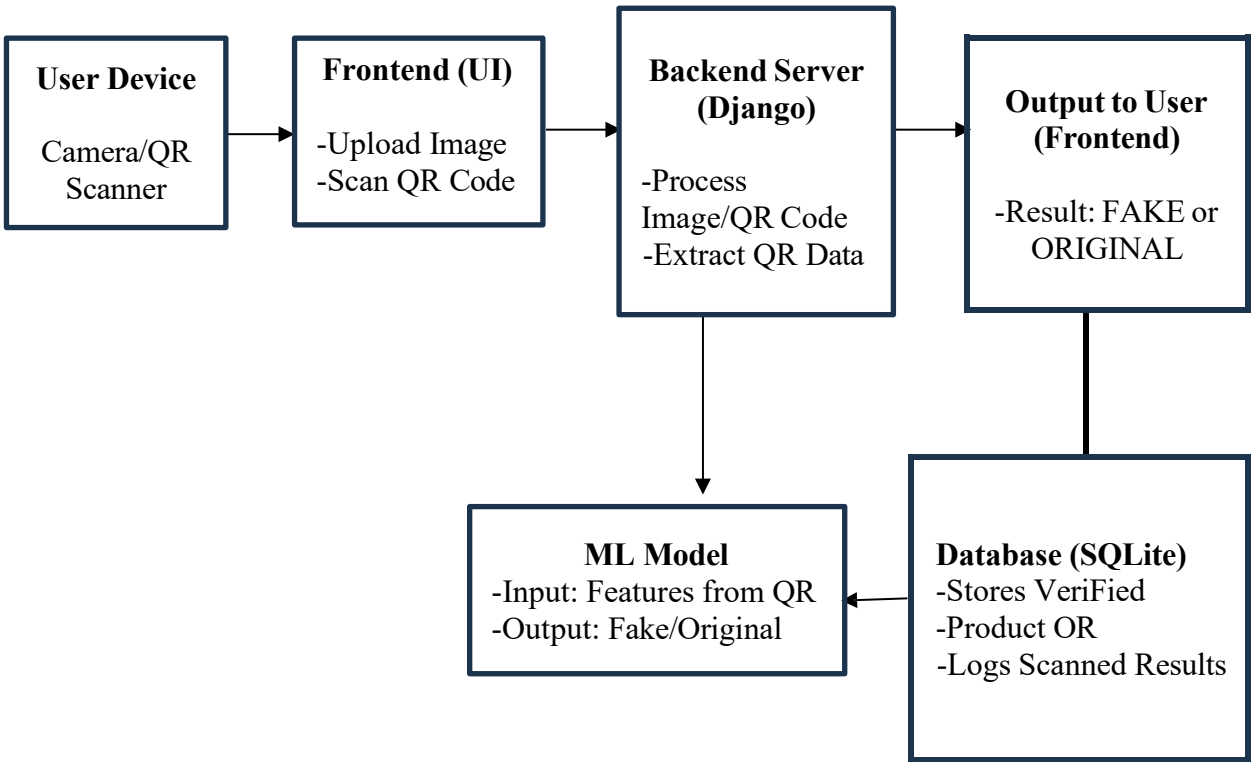

Fig-2: System Architecture Diagram

The front-end, built using HTML, CSS, and Bootstrap, communicates with the Django backend via RESTful APIs. Users upload QR code images or scan them live using their webcams. The backend leverages the Pyzbar library for QR decoding and retrieves product information from the SQLite database. If the QR code is valid, the backend proceeds to analyze it using the machine learning model stored as a .pkl file. The result is then returned to the front end for display. Advantages of this setup:

- Lightweight and responsive
- Works on both desktop and mobile browsers
- No need for external verification tools
- Flexible architecture for integration with other systems

VI. SECURITY

Security is paramount, especially in systems dealing with consumer protection. The following measures are implemented:

- **User Authentication**: Secure login system with hashed passwords for both user and admin roles.
- **Data Integrity**: Product entries are only editable by admins.

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- **QR Tampering Detection**: Unusual scan behaviour (e.g., scanning the same code from different IPs rapidly) is logged and flagged.
- **Secure Model Handling**: The machine learning model is serialized and loaded only during prediction, minimizing risk.
- **Audit Logging**: Every scan and prediction event is recorded, enabling retrospective analysis.

VII. RESULT AND DISCUSSION

The system was tested on a balanced dataset of 1,000 QR samples (500 genuine and 500 fake). The Random Forest model achieved the following performance metrics:

- Accuracy: 97.2%
- Precision: 96.8%

Response time for a prediction averaged 2.8 seconds. In user testing, participants appreciated the clean interface and clear result display. Admins could view scan history and manage products efficiently from the dashboard. One limitation noted was that image quality significantly affected QR decoding accuracy, which is being addressed in future updates.

VIII. CONCLUSION

In today's fast-paced digital world, the issue of fake and duplicate products has become a serious threat—not only to businesses but also to customers who trust what they buy. This project, Identification of Fake Product by QR Code using machine learning, was created with the goal of helping users easily verify whether a product is genuine or fake by simply scanning a QR code.

Using Machine Learning and a QR code scanning system, the project makes it feasible to detect product authenticity in a few seconds. When a user uploads or scans a product's QR code, the system reads the code, checks it against the database, and then uses a trained ML model to classify the product as either "Original" or "Fake". This makes the entire process fast, smart, and reliable.

Throughout the development, proper care was taken to test every part of the system—such as login authentication, QR scanning, data handling, and user interaction. Using different types of including unit and integration tests, functional test, system test, and user acceptance testing, the system was made more accurate and user-friendly. It ensures that the platform runs smoothly and provides clear feedback in case something goes wrong (like invalid inputs or missing data).

This approach also makes it easier to customers make safer buying decisions, but also supports businesses in safeguarding their brand and fight back against counterfeiters. It's easy to use, works in real-time, and adds value to both product makers and users.

In conclusion, this project proves how combining simple user actions (like scanning a QR code) using advanced machine learning models can solve real-world problems. With further improvements and updates, this system has the potential to be integrated into retail stores, e-commerce apps, or product packaging to create a safer and smarter shopping experience for everyone.

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