



National University
of computer and emerging sciences

Foundation of Advancement
Of Science and Technology



PROJECT PROPOSAL

AI & BLOCKCHAIN-ENABLED COSMETICS SUPPLY CHAIN TRANSPARENCY AND COUNTERFEIT DETECTION

COURSE:

BLOCKCHAIN & CRYPTOCURRENCY (CS-4049)

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Abstract

The proposed project aims to create an integrated system that combines Artificial Intelligence (AI) and Blockchain technologies to enhance transparency and traceability in the cosmetics supply chain, while also detecting potential counterfeit products. The solution will record every step of the supply chain on an immutable ledger and utilize AI-driven predictive analytics and anomaly detection to flag discrepancies. This system addresses real-world challenges such as counterfeiting, ethical sourcing, and supply chain inefficiencies.

1 Introduction

The cosmetics industry faces significant challenges including counterfeiting, opaque supply chain processes, and difficulties in verifying ethical sourcing. Consumers increasingly demand transparency regarding the products they purchase, while manufacturers and retailers seek to maintain brand integrity and ensure product authenticity.

Our project addresses these challenges by:

- **Ensuring Transparency:** Recording each transaction and movement in the supply chain on a blockchain ledger.
- **Detecting Counterfeits:** Using AI to analyze product data and supply chain information to identify potential counterfeit products.
- **Improving Supply Chain Efficiency:** Offering predictive analytics to optimize inventory management and forecast demand.

2 Suggested/Committed Features

A. Blockchain Integration

- **Immutable Supply Chain Ledger:** Record and timestamp each supply chain event—from raw material sourcing to retail—ensuring no alteration can occur.
- **Smart Contracts:** Automate key processes such as quality control verification, payment release, and compliance checks when predefined conditions are met.

B. AI-Powered Predictive Analytics

- **Anomaly Detection:** Train AI models (e.g., using unsupervised learning techniques or autoencoders) on the authentic product data to flag discrepancies.
- **Textual Analysis:** Use NLP models (BERT, DistilBERT) to analyze product descriptions and ingredient lists, ensuring consistency with known authentic data.

3 Key Features

- **End-to-End Traceability:** Every step from manufacturing to retail is recorded on the blockchain, enabling full visibility.
- **Counterfeit Detection:** AI models compare live product data against the authenticated baseline to flag irregularities.
- **Smart Contracts for Automation:** Automated workflows reduce manual oversight and improve process efficiency.
- **Consumer Empowerment:** End users can verify product authenticity by retrieving the blockchain record.
- **Ethical Sourcing Verification:** Transparent tracking of ingredient origins ensures compliance with ethical sourcing standards.

4 Simple Workflow

Data Collection & Registration

- Suppliers, manufacturers, and logistics partners input product and shipment data.
- An open-source dataset is used as the reference for authentic cosmetic product data.

Blockchain Recording

- Each transaction, quality check, and product movement is recorded on an immutable blockchain ledger.
- Smart contracts automatically validate the recorded data and execute actions (e.g., trigger payment upon delivery).

AI Analysis & Anomaly Detection

- Preprocessed data is fed into AI models to predict demand and detect discrepancies.
- NLP techniques analyze product descriptions and ingredient lists against baseline data.

Consumer Verification

- A consumer searches the product to access its verified blockchain history.
- Any flagged anomalies trigger alerts for further investigation.

5 Technology Stack

Component	Technology/Tool
Blockchain Platform	Ethereum (using Solidity for smart contracts) or Hyperledger Fabric for private ledger
Smart Contract Development	Solidity, Truffle Suite for testing and deployment
AI & Machine Learning	Python (TensorFlow, PyTorch, Scikit-learn, Hugging Face Transformers for NLP)
Backend Framework	Node.js with Express or Python Flask
Database	MongoDB or PostgreSQL for off-chain data storage
Frontend Development	React.js or Angular for dashboard and consumer verification interface

6 Benefits

- **Enhanced Transparency:** An immutable blockchain ledger builds trust by providing a verifiable product history.
- **Counterfeit Prevention:** AI-driven anomaly detection reduces the incidence of counterfeit products entering the market.
- **Operational Efficiency:** Automated smart contracts streamline supply chain processes, reducing administrative overhead.
- **Improved Decision Making:** Predictive analytics support informed inventory and demand forecasting decisions.
- **Consumer Confidence:** Easy access to product history reassures consumers of authenticity and ethical sourcing.

7 Next Steps

Research & Planning

- Conduct a literature review on blockchain and AI implementations in supply chain management.
- Define specific use cases and outline project milestones.

Data Preparation

- Import and preprocess an open-source dataset.
- Develop feature extraction pipelines and prepare the dataset for AI model training.

Prototype Development

- Develop a prototype with basic blockchain integration and AI models.
- Build and deploy smart contracts to record supply chain transactions.

Integration & Testing

- Integrate AI models with the blockchain system.
- Simulate supply chain scenarios and test the counterfeit detection mechanism.

Documentation & Presentation

- Document design decisions, architecture, and test results.
- Prepare a presentation demonstrating the system's capabilities and benefits.