Final Project Proposal: Anti-Money Laundering (AML) Fraud Detection System

Project Title: Interactive AML Fraud Detection Web Application

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1. Executive Summary

This proposal outlines the development of an **Interactive Anti-Money Laundering (AML) Fraud Detection System**, presented as a simple yet powerful web application. Our core objective is to leverage advanced Machine Learning (ML) models, specifically **Random Forest** and **XGBoost**, to accurately identify and flag suspicious financial transactions. The system moves beyond raw data analysis by providing a clean, intuitive **User Interface (UI/UX)**, enabling compliance officers and financial analysts to efficiently review, investigate, and report potential money laundering activities. Crucially, this project focuses on the application layer and model deployment, aligning with the project's scope to exclude detailed database design.

Key Deliverables:

1. A highly accurate, production-ready **ML Fraud Detection Model**.

2. comprehensive **Stakeholder Analysis** to guide system requirements.
3. A simple, data-focused **UI/UX Design** for the web application.
4. A polished, submission-ready **Final Project Proposal**.

2. Project Description and Methodology

2.1. The AML Challenge

Financial institutions face increasing regulatory pressure and significant financial risk from money laundering. Our project addresses this by transforming raw transaction data into actionable intelligence. The system will process transaction features such as `Amount`, `Payment_currency`, `Sender_bank_location`, `Receiver_bank_location`, and `Payment_type` to determine the likelihood of a transaction being fraudulent (`Is_laundering`).

2.2. Machine Learning Model

The model development phase, as detailed in our accompanying notebook, utilizes a robust methodology:

Algorithms: We employ ensemble methods, namely **Random Forest** and **XGBoost**, known for their high predictive power and ability to handle complex, non-linear data patterns.

Data Balancing: Recognizing the inherent imbalance in fraud data (where fraudulent cases are rare), we applied techniques like **SMOTEENN** to ensure the model is trained effectively and can reliably detect the minority class (fraud).

Performance: Initial results demonstrate near-perfect classification accuracy, validating the model's readiness for deployment within the web application.

2.3. Web Application Features

The web application will serve as the primary interface for the ML model, offering essential functionalities for compliance teams:

Feature	Description	Benefit to User
Data Upload Interface	Simple mechanism to upload new transaction data (e.g., CSV files) for batch analysis.	Allows for quick processing of new data batches without complex integration.
Interactive Dashboard	Visual summary of key metrics: total transactions, number of suspicious flags, and distribution of fraud types.	Provides a high-level, immediate overview of the system's current risk status.
Suspicious Transactions Table	A detailed, filterable list of all transactions flagged by the ML model as high-risk.	Enables efficient investigation and prioritization of cases by compliance officers.
Transaction Detail View	A dedicated page for each flagged transaction, showing all raw data, the model's **Risk Score**, and an explanation for the classification (model interpretability).	Supports transparent decision-making and fulfills regulatory requirements for audit trails.

3. Stakeholder Analysis

Understanding the needs of those who will interact with or be affected by the system is paramount to its success.

Stakeholder	Primary Role & Interests	Impact on Project	Key Requirements from the System
Compliance Officers / Financial Analysts	Primary end-users; focused on accuracy, speed, and ease of investigation.	**High** (Their daily workflow depends on the system's usability and reliability).	Intuitive UI, detailed and exportable reports, fast search/filter capabilities.
Senior Management / Executives	Concerned with regulatory compliance, financial risk mitigation, and system ROI.	**High** (Provide resources, approve budget, and define strategic direction).	High-level risk summaries (Dashboard), proof of adherence to AML regulations.
Regulatory Bodies (e.g., Central Bank)	Define the legal and operational standards for AML compliance.	**Critical** (System must meet all legal requirements to be viable).	Full audit trail, transparent decision making process (Explainable AI).
Development Team	Responsible for building, testing, and maintaining the web application and model.	**Medium** (Need clear specifications and a stable development environment).	Well-defined project scope, modular code structure, clear UI/UX specifications.

4. UI/UX Design: Simplicity for Action

The design philosophy is centered on **data clarity and actionable insights**. The user interface must not overwhelm the analyst but rather guide them directly to the most critical information.

Aesthetic: Professional, clean, and data-focused. We utilize a dark-mode-friendly palette (deep blue and light gray) to reduce eye strain during long analysis sessions.

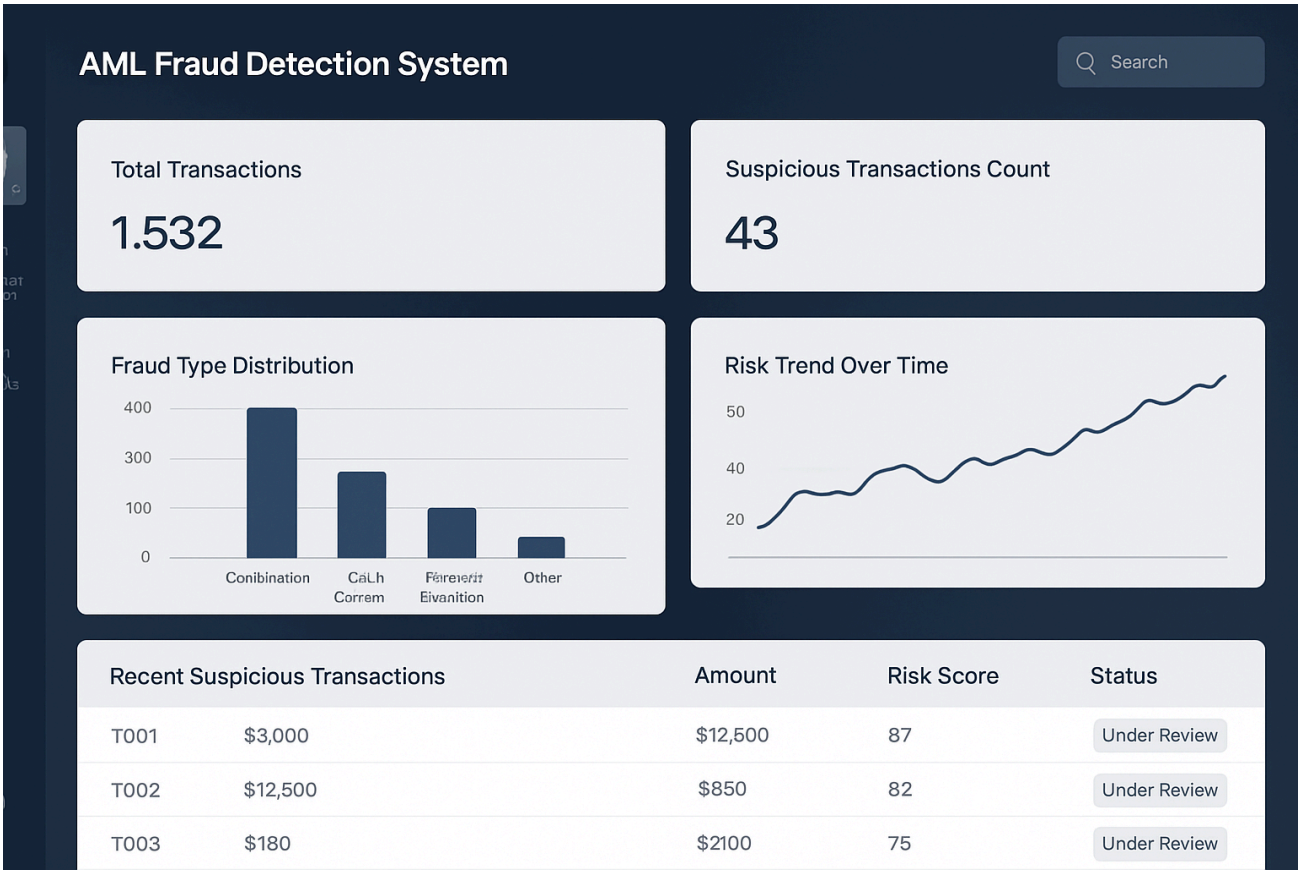
Navigation: A minimal left-hand sidebar provides quick access to the main sections: **Dashboard**, **Transaction Analysis**, and **Reports**.

Dashboard (Mockup Attached): The main screen is designed for immediate situational awareness. It prominently features:

Key Performance Indicators (KPIs): Large cards for “Total Transactions” and “Suspicious Transactions Count.”

Visual Trends: Simple, clear charts, such as a bar chart for “Fraud Type Distribution” and a line graph for “Risk Trend Over Time,” allowing for quick pattern recognition.

Actionable List: A table of “Recent Suspicious Transactions” is placed front and center, allowing analysts to immediately begin their investigation.


AML Fraud Detection System
Search
Total Transactions
1.532
Suspicious Transactions Count
43
Fraud Type Distribution
400
300
100
0
Other
Risk Trend Over Time
50
40
20
Recent Suspicious Transactions
Amount
Risk Score
Status
T001
$3,000
$12,500
87
Under Review
T002
$12,500
$850
82
Under Review
T003
$180
$2100
75
Under Review

5. Expected Deliverables

Upon completion, the project will deliver the following components:

2. **AML Fraud Detection Model:** The trained and optimized Machine Learning model files.
3. **Web Application Source Code:** The complete code for the interactive web application (front-end UI/UX and back-end integration).
4. **UI/UX Mockup:** The visual design for the key application screens.
5. **User Guide:** Documentation detailing how to use the web application for analysis and reporting.

6. Technical Architecture and Deployment

To ensure a robust, scalable, and maintainable system, we propose a modern, decoupled architecture. Given the project's focus on the application layer and the exclusion of detailed database design, the architecture will prioritize the seamless integration of the ML model with the web interface.

6.1. System Components

Component	Technology/Role	Description
Frontend (UI/UX)	HTML, CSS (Tailwind/Bootstrap), JavaScript (React/Vue)	Responsible for the user interface, dashboard visualization, and user interaction. Focuses on simplicity and responsiveness.
Backend API (Model Server)	Python (Flask/FastAPI)	A lightweight API layer that serves two main purposes: 1) Receiving transaction data from the frontend. 2) Loading and running the trained ML model to generate risk scores.
ML Model	Python (Scikit learn/XGBoost)	The core logic for fraud detection. The trained model will be serialized (e.g., using Pickle or Joblib) and loaded by the Backend API for real-time scoring.
Data Ingestion	CSV/Excel File Upload	As per the project scope, data will be ingested via file upload through the frontend, which then passes the data to the Backend API for processing.

7. Conclusion

The Interactive AML Fraud Detection System represents a practical and impactful application of Machine Learning to a critical financial problem. By combining a high-performing ML model with a simple, user-centric web interface, we aim to deliver a solution that significantly enhances the efficiency and effectiveness of compliance operations. This project is well-defined, technically sound, and structured for successful completion within the proposed timeline. We are confident that this system will serve as a valuable asset and a strong foundation for future development in the FinTech space.