INTEGRATED LAND AND REAL ESTATE DIGITALIZATION AND FRAUD PREVENTION SYSTEM

Group -06

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1. Introduction

1.1 Purpose

This document is the Software Requirements Specification (SRS) for the Integrated Land and Real Estate Digitalization and Fraud Prevention System. The system is designed to ensure transparent land and property transactions using Artificial Intelligence (AI) and Blockchain Technology. The primary aim is to prevent fraud, digitalize land records, and ensure that citizens can securely interact with the system while the government maintains oversight.

This SRS will serve as a detailed guide for developers, stakeholders, auditors, and system administrators. It defines the system's functionalities, performance standards, security protocols, and non-functional requirements.

1.2 Scope

- Digitalize all land-related services under a single platform, including E-Mutation, E-Porcha, E-Dakhila, and more.
- Employ AI to cross-verify user financial information (NID, TIN, Salary, Income Sources) to ensure transactions align with their legal financial standing.
- Leverage Blockchain to secure all land and property transactions, ensuring immutability and transparency.
- Consolidate and Simplify land tax management by sending tax payment reminders, generating real-time reports, and preventing land transfers with unpaid taxes.
- Provide auditing and review features for government authorities to manually investigate flagged accounts and transactions.

1.3 Vision

- Provide transparent, fraud-resistant, and accessible land management services.
- Ensure that all citizens can securely buy, sell, and manage land holdings with confidence that the system adheres to the highest standards of integrity.
- Reduce fraud by implementing AI to flag suspicious land acquisition attempts.
- Enhance public trust by allowing real-time visibility into the status of property transactions.

1.4 Mission

- Centralize all land-related activities into a single digital platform.
- Enable the government to track, verify, and manage land transactions more effectively.
- Protect public assets by preventing fraudulent land ownership transfers.

- Ensure transparency through blockchain, allowing all transactions to be traceable and immune to tampering.

1.5 Objectives

- **To ensure transparency:** Enable clear visibility for users and government officials into the status of land ownership and transactions.
- **To reduce fraud:** Utilize AI to cross-check user financial data and block suspicious activities.
- **To streamline services:** Provide digital services that simplify land-related activities such as ownership transfer, tax payment, and land registration.
- **To integrate and modernize:** Integrate existing land services and make them accessible in a single unified system.

1.6 Stakeholders and User Characteristics

- **Government Officials:** Administrators who will manage flagged transactions, approve or reject land transactions, and review land ownership transfers.
- **Citizens:** Primary end users of the system, responsible for registering and managing land ownership, paying taxes, and viewing transaction statuses.
- **Auditors:** Oversight personnel who will review flagged accounts and investigate anomalies in land transactions.
- **Developers:** Real estate developers responsible for registering new property projects and ensuring compliance with the system's requirements.

2. Overall Description

2.1 Product Perspective

The Integrated Land and Real Estate Digitalization and Fraud Prevention System is a comprehensive, unified platform for managing land transactions and property ownership. It aims to replace outdated manual processes with modern digital services powered by AI and blockchain technology. By consolidating various services such as E-Mutation, E-Porcha, and E-Dakhila into a single interface, the system will streamline land management processes and offer users a transparent view of their property records.

2.2 Product Functions

- **AI-Driven Verification:** The system will use AI to cross-verify the financial details of buyers to ensure their ability to purchase land.
- **Blockchain for Transaction Security:** All transactions will be logged on a blockchain, making them immutable and tamper-proof.
- **Land Registration Services:** The system will provide digital land registration services, including E-Mutation and E-Porcha.

- **Tax Management:** Users will be able to view tax dues, make payments, and track their tax payment history.
- **Notifications and Alerts:** The system will send real-time notifications related to transaction status, flagged accounts, tax dues, and approvals.

2.3 Operating Environment

- **Platform:** The system will be cloud-hosted and accessible via web browsers and mobile apps. It must be compatible with modern web browsers such as Google Chrome, Mozilla Firefox, and Microsoft Edge, as well as mobile devices running Android and iOS.

- **APIs:** The system will integrate securely with external systems such as the NID, TIN, and land registry databases to retrieve and validate user data.

- **Blockchain Infrastructure:** The system will run a distributed blockchain network, leveraging decentralized ledgers for transparency and data integrity.

2.4 Constraints

- **Legal Constraints:** The system must comply with local land laws, tax regulations, and data protection policies, such as the General Data Protection Regulation (GDPR). All user data must be securely stored and only accessed by authorized personnel. Changes to land laws must be reflected in the system within 30 days.

- **Technological Constraints:** Blockchain and AI technology must be fully integrated with government systems, which may require collaboration with third-party providers. The system must be scalable enough to handle large volumes of users during peak periods.

- **Financial Constraints:** The system must be developed within the allocated budget, ensuring that operational costs do not exceed predefined limits.

2.5 Assumptions and Dependencies

- **Internet Access:** All users, including citizens, government officials, and developers, will have access to a stable internet connection.

- **API Accessibility:** It is assumed that national databases like the NID and TIN systems will be accessible through secure APIs to ensure seamless data validation.

- **Stakeholder Support:** Full cooperation from government bodies, tax authorities, and legal authorities is assumed to ensure smooth operations.

- **Blockchain and AI Infrastructure:** Assumes that the blockchain and AI technologies chosen will support secure, scalable, and efficient operations without compatibility issues.

2.6 Business Rules

- **BR-1**: All land transactions must be validated with the buyer's **NID**, **TIN**, and financial background before final approval.

- **BR-2**: No land transaction can be processed until the user's tax obligations are fully settled.

- **BR-3**: AI will automatically flag land purchases exceeding the individual's declared income or assets for further verification.
- **BR-4**: The system will restrict the sale of land without valid blockchain validation to prevent tampering.
- **BR-5**: Government officials must manually review and approve any land transfer flagged by AI for discrepancies or fraud.
- **BR-6**: Users will be required to re-verify their financial details (e.g., salary, tax status) annually to ensure that they remain compliant for any future land transactions.

3. User Requirements

3.1 Citizen Requirements

- Ability to register land ownership and initiate transactions online.
- Access to view E-Mutation and E-Porcha documents.
- Option to pay land taxes online and receive notifications about due dates.
- Ability to view and download transaction histories and tax payment receipts.

3.2 Government Official Requirements

- Ability to manage flagged transactions, reviewing AI-detected fraud cases.
- Approve or reject land transactions based on blockchain and AI insights.
- Generate real-time reports on land ownership, taxes, and flagged activities.
- Monitor land zoning regulations and compliance with legal requirements.

3.3 Auditor Requirements

- Access to all flagged transactions for manual investigation.
- Ability to review blockchain records for immutable transaction history.
- Generate and download reports for investigation and compliance auditing.

3.4 Developer Requirements

- Ability to register new real estate projects, providing supporting documents.
- Access to view land ownership status and zoning information.
- Verify land ownership and compliance with zoning laws before development.

4. System Requirements

4.1 Hardware Requirements

- **Server Infrastructure:** The system must be hosted on a robust cloud-based infrastructure. Initial deployment should have:
    - 32 GB RAM and 1 TB storage for each application server.
    - High-performance multi-core processors for AI and blockchain processing tasks.
    - Dedicated blockchain nodes with 64 GB RAM and multi-core processors for transaction handling.
- **Backup Servers:** Servers with 32 GB RAM and 500 GB storage must be available for backups and failover scenarios.
- **End-User Devices:** The system should support devices with a minimum of 4 GB RAM and modern web browsers (Chrome, Firefox, Edge) and mobile devices running Android 8 or higher or iOS 12 or higher.

4.2 Software Requirements

- **Operating Systems:** The backend servers should run on Linux-based systems (e.g., Ubuntu, CentOS) for stability and security. Development environments should be supported on Windows and macOS.
- **Database Management:** A PostgreSQL or MySQL relational database should be used for user data and transaction logs. A NoSQL database like MongoDB may be used for storing large-scale metadata or audit logs.
- **Blockchain Platform:** The system should utilize Ethereum or Hyperledger for its blockchain infrastructure, ensuring tamper-proof, secure, and scalable record-keeping.
- **AI Framework:** TensorFlow or PyTorch should be used for AI model training and real-time fraud detection.
- **Web Development Framework:** The front-end should be developed using React.js or Angular for a scalable and responsive user interface, while the backend will use Node.js or Django for API handling and integration.

4.3 Network Requirements

- **Internet Bandwidth:** A minimum of 100 Mbps for servers to handle API interactions with government databases and to ensure smooth blockchain synchronization.
- **Latency:** The system must support low-latency interactions between the user interface and the server with a maximum response time of 100 ms for basic transactions.
- **Network Security:** All data transmissions between the server and user devices must be encrypted using TLS 1.2 or higher.

5. Functional Requirements

5.1 User Management and Authentication

- FR-1: The system shall allow users (citizens, developers, government officials) to register using their NID, TIN, and other personal details such as employment information and salary.
- FR-2: The system shall use Two-Factor Authentication (2FA) for all users, requiring a second authentication step via email or SMS for secure logins.
- FR-3: Users will be assigned roles based on their position (e.g., citizen, government admin, auditor, developer), and role-based access control (RBAC) will ensure that each user can only access relevant features.

5.2 Land and Property Registration

- FR-4: Citizens will be able to submit land ownership documents digitally. The system will validate these documents against existing government records using AI.
- FR-5: The system shall cross-check income, salary, and other financial details of users to verify that land purchases match their financial standing.
- FR-6: The system will enable users to track the status of their land or property registration, including submission reviews, approvals, and blockchain-based confirmations.

5.3 AI-Based Fraud Detection and Verification

- FR-7: The system will use AI algorithms to detect any discrepancies between user income, salary, and land ownership, flagging suspicious transactions.
- FR-8: If the AI detects a significant financial inconsistency in a land transaction, the system will block the transaction and alert government auditors for further review.
- FR-9: The system will provide the capability for AI models to learn and improve over time by analyzing fraud detection patterns.

5.4 Blockchain Integration for Transactions

- FR-10: All property transactions must be securely logged on a blockchain ledger, including buyer and seller details, transaction amount, and property metadata.
- FR-11: The blockchain ledger must be immutable and publicly accessible, allowing authorized government bodies to audit transaction histories in real-time.
- FR-12: The system shall generate unique blockchain IDs for each transaction, and these will be linked to digital certificates or verification IDs used in legal documents.

5.5 Tax Management

- FR-13: The system will integrate with the national tax authority to retrieve property tax information and send notifications to users for tax dues and deadlines.

- FR-14: Users with outstanding taxes will be restricted from performing land transfers or ownership changes until tax obligations are cleared.

- FR-15: Tax receipts will be automatically generated and logged in the system upon payment, with both the user and government receiving notifications.

5.6 Notifications and Alerts

- FR-16: The system will send real-time notifications to users for any flagged land transactions, pending property tax payments, and registration status updates.

- FR-17: Users will have the ability to customize their notification preferences, including opting in for email or SMS alerts for tax and registration updates.

5.7 Developer and Auditor Functions

- FR-18: Real estate developers will be able to register new property projects and provide legal documents to verify land ownership.

- FR-19: Developers will be required to ensure compliance with land zoning and environmental laws through integrated zoning data checks.

- FR-20: Auditors will be granted access to review flagged transactions, fraud alerts, and the full transaction history on the blockchain for investigative purposes.

5.8 Existing Service Integrations

- FR-21: The system will integrate with existing land services like E-Mutation, E-Porcha, and E-Dakhila, allowing users to view, download, and manage their land-related documents digitally.

- FR-22: The system will track E-Mutation requests in real-time, notifying users of the status, whether pending, under review, or approved.

- FR-23: The system will incorporate Digital Mouza Maps that allow users to view land zoning information, property boundaries, and other key data.

5.9 Reporting and Analytics

- FR-24: The system will generate detailed real-time reports for administrators, detailing flagged transactions, land transfers, and tax payment histories.

- FR-25: The AI system will have built-in reporting for fraud detection trends, allowing the government to adjust policies and refine transaction thresholds.

- FR-26: Predictive analytics will be employed to analyze potential future fraud trends based on historical transaction data and user profiles.

6. Non-Functional Requirements

6.1 Performance Requirements

- NFR-1: The system must support up to 10 million concurrent users with a maximum page load time of 3 seconds for standard actions such as login, land search, and document viewing.
- NFR-2: AI verification processes should not exceed 15 seconds per transaction under peak loads, ensuring quick fraud detection.
- NFR-3: Blockchain transactions should be confirmed and posted within 10 seconds for real-time immutability.

6.2 Security Requirements

- NFR-4: All sensitive data, including personal, financial, and transactional records, must be encrypted using AES-256 encryption for data at rest and TLS 1.2 or higher for data in transit.
- NFR-5: Role-based access control (RBAC) must be enforced to ensure that users only have access to features and data relevant to their role.
- NFR-6: The system must enforce multi-factor authentication (MFA) for all high-privilege users such as government administrators and auditors.

6.3 Usability Requirements

- NFR-8: The system must support multi-language interfaces, offering users the option to interact with the system in both English and Bengali.
- NFR-9: The system must comply with Web Content Accessibility Guidelines (WCAG) 2.1, ensuring that users with disabilities (such as those using screen readers or needing keyboard navigation) can access the platform easily.
- NFR-10: Tooltips and contextual help must be integrated across all user-facing forms and actions, providing guidance on how to complete complex tasks.

6.4 Reliability

- NFR-11: The system must maintain 99.9% uptime, with robust failover mechanisms in place to handle server failures or maintenance.
- NFR-12: Automatic backups of the blockchain ledger and user data must occur at least once every 6 hours. Backups should be stored across geographically distributed servers to ensure data availability.
- NFR-13: In case of a system failure, recovery should occur within 30 minutes, and no more than 1 hour of data should be lost.

6.5 Scalability

- NFR-14: The system must scale horizontally, supporting the ability to add more servers during peak usage periods. It should be able to handle up to 50 million users with no degradation in performance.

- NFR-15: The database should be capable of storing at least 10 TB of transaction data in its initial deployment, with the option to expand storage dynamically as data grows.

6.6 Legal and Compliance

- NFR-16: The system must fully comply with the General Data Protection Regulation (GDPR), ensuring that users' personal data is stored, processed, and transmitted securely.

- NFR-17: All transactions, audits, and tax payments must comply with local land laws and tax regulations.

- NFR-18: The system must ensure that all updates to land laws, regulations, and tax policies are implemented in the system within 30 days of their legal publication.

6.7 Availability

- NFR-19: The system should be available 24/7, with downtime for maintenance being minimized to less than 4 hours per month.

- NFR-20: The system must support real-time synchronization of blockchain data and government databases to ensure that land records are always up-to-date and accurate.

6.8 Interoperability

- NFR-21: The system should provide secure APIs for external systems, including government databases, auditors, and third-party services.

- NFR-22: Data import and export must support standardized formats such as CSV, JSON, and XML to ensure compatibility with external systems.

- NFR-23: The system should integrate with popular payment gateways to handle secure tax payments and transaction fees.

7. Interface Requirements

7.1 User Interface (UI) Requirements

- UI-1: The interface must follow a responsive design principle, adapting seamlessly to various devices, including desktops, tablets, and mobile phones.
- UI-2: The system must include a dashboard for users, providing an overview of land holdings, transaction statuses, tax information, and flagged transactions in a visually appealing manner using graphs and charts.
- UI-3: The dashboard for government officials must provide real-time transaction overviews, quick links to flagged transactions, and detailed analytics.
- UI-4: A search functionality must allow users to find specific land records using property ID, NID, owner name, or other relevant identifiers.
- UI-5: All forms should include error validation and real-time feedback to ensure that users can easily identify and correct errors when submitting information.

7.2 Forms and Data Entry Interfaces

- UI-6: User registration and land registration forms must support document uploads (PDF, JPEG, DOCX) and have real-time validation to ensure correct data input (e.g., NID format validation).
- UI-7: AI-driven forms will auto-complete data fields (where available), pulling from government databases such as NID and TIN.
- UI-8: Forms for tax payment and land transactions must allow users to review the entered data before submitting, ensuring accuracy.

7.3 External System Integration

- UI-9: The system must securely integrate with NID, TIN, and the national land registry through APIs for real-time data validation and retrieval of user financial information.
- UI-10: Payment gateways must be integrated to support online tax payments, offering options for secure card transactions, mobile payments, and bank transfers.
- UI-11: Integration with Digital Mouza Maps must be provided for users to visually view land boundaries, zoning information, and ownership data.

7.4 System-to-System Interfaces

- UI-12: The system should expose secure RESTful APIs for external auditors and government agencies to retrieve transaction logs, audit trails, and compliance reports.
- UI-13: The system will also support external land registry systems to access blockchain-validated transaction data to ensure synchronization across platforms.

8. Design Constraints

8.1 Technology Constraints

- DC-1: The system must use Ethereum or Hyperledger as the blockchain infrastructure, supporting smart contracts for automated land transaction approvals.
- DC-2: The AI model for fraud detection must be built using TensorFlow or PyTorch, and it must be trained with real-world land transaction and financial data.
- DC-3: The system will be hosted on a cloud infrastructure (e.g., AWS, Microsoft Azure, Google Cloud) for scalability, requiring integration with cloud services like S3 for secure data storage.

8.2 Security Constraints

- DC-4: All communications between client devices and servers must be encrypted using TLS 1.2 or higher to ensure secure transmission of sensitive data.
- DC-5: The system must use role-based access control (RBAC), ensuring that only authorized users (e.g., auditors, developers, citizens) can access specific features and data.
- DC-6: All passwords stored in the system must be encrypted using bcrypt or a similarly secure hashing algorithm to protect user credentials.

8.3 Architectural Constraints

- DC-7: The system architecture must be microservices-based, allowing for independent scalability of components such as AI processing, blockchain nodes, and user management.
- DC-8: The database architecture must be designed to support ACID transactions to ensure data consistency during simultaneous land transactions.

8.4 Regulatory and Compliance Constraints

- DC-9: The system must comply with ISO 27001 standards for information security management, especially in handling user financial and personal data.
- DC-10: The system must comply with GDPR regulations, ensuring that user data is collected, processed, and stored in accordance with global privacy laws.

9. Requirements Analysis and Validation

9.1 Validation Process

- **User Acceptance Testing (UAT):** A comprehensive UAT phase will involve real-world scenarios to validate that the system meets the needs of citizens, developers, and government officials. Test cases will include:
    - Simulating land transactions of varying complexity to ensure that the system flags suspicious activities based on predefined fraud thresholds.

- Submitting land registration applications and validating the end-to-end flow from document submission to blockchain registration.

- **Performance Testing:** The system will undergo stress testing to validate that it can handle 10 million concurrent users and process 500 transactions per second without performance degradation.

- **AI Fraud Detection Testing:** Various financial profiles will be tested to ensure that the AI system correctly identifies discrepancies and flags fraudulent transactions. Simulated land purchases by users with mismatched incomes will be tracked to ensure the system's accuracy in fraud detection.

9.2 Acceptance Criteria

- AC-1: The system must pass all UAT tests, ensuring that each user role (citizen, auditor, developer, government official) can perform their tasks seamlessly.

- AC-2: The AI system must achieve an accuracy rate of 95% in detecting fraudulent transactions during simulated testing.

- AC-3: All forms and transactions must be securely stored and validated in the blockchain within 10 seconds of submission.

- AC-4: The system must comply with security, legal, and accessibility standards before deployment in any region.

10. Schedule and Budget

10.1 Project Phases and Milestones

Phase 1: Requirement Gathering and Analysis (Month 1-2)

- Gather detailed requirements from stakeholders (citizens, auditors, government officials).

- Develop high-level architecture and select blockchain and AI frameworks.

- Deliverable: Initial System Requirements and Architecture Document.

Phase 2: System Design and Prototyping (Month 3-4)

- Finalize system architecture (microservices, database design, AI model selection).

- Prototype user interface (UI) and blockchain integration.

- Deliverable: Prototype with basic functionality for land registration, user authentication, and blockchain integration.

Phase 3: Development and Integration (Month 5-8)

- Full system development: AI fraud detection integration, blockchain implementation, user management, and tax management.
- API integrations with external systems (NID, TIN, land registry).
- Security features (encryption, role-based access control).
- Deliverable: Fully functional system with initial testing.

Phase 4: Testing and Quality Assurance (Month 9-10)

- Functional Testing: Ensure that all components (AI, blockchain, tax management) function as expected.
- Performance Testing: Load testing for scalability (support for 10 million users, handling up to 500 transactions/second).
- Security Testing: Penetration testing and security audit (data encryption, access control).
- Deliverable: Testing reports and system readiness for user acceptance testing (UAT).

Phase 5: Deployment and User Training (Month 11-12)

- Deployment of the system in a live environment.
- User training for government officials, auditors, and developers.
- Deliverable: Final system deployed, user documentation, and training materials.

10.2 Detailed Budget

• Development and Personnel:	$2,00,000
• Cloud Infrastructure and Blockchain:	$1,00,000
• AI and Data Integration:	$90,000
• Security and Testing:	$30,000
• Training and Documentation:	$20,000
Total Estimated Budget:	$422,000

11. User Documentation

11.1 Citizen User Guide

- How to register on the platform using **NID** and **TIN**.
- How to submit land registration documents.
- How to pay land taxes online and track payment history.

- How to receive notifications and track registration status.

11.2 Administrator User Manual

- How to manage flagged transactions and verify land transfers.
- How to generate and view reports for tax collection and fraud detection.
- How to manage users, roles, and permissions.

11.3 Auditor Guide

- How to access the blockchain ledger to investigate land transactions.
- How to review and approve/reject flagged transactions.
- How to generate audit reports and download transaction logs for further investigation.

12. Glossary and Appendices

12.1 Glossary

- **AI (Artificial Intelligence):** Technology that allows computers to analyze data, make decisions, and perform tasks in a way that mimics human intelligence.
- **Blockchain:** A decentralized ledger that records transactions in a secure and tamper-proof manner.
- **E-Mutation:** Digital service that handles the transfer of land ownership records.
- **E-Porcha:** A digital document that provides ownership details of land.
- **E-Dakhila:** An online service that provides records of land tax payments.
- **NID (National Identification Number):** A unique number issued to citizens for identification purposes.
- **TIN (Tax Identification Number):** A unique number issued for tax purposes.

12.2 Acronyms

- **API:** Application Programming Interface
- **AI:** Artificial Intelligence
- **RBAC:** Role-Based Access Control
- **UI/UX:** User Interface/User Experience

- **MFA:** Multi-Factor Authentication
- **GDPR:** General Data Protection Regulation

12.3 References

- ISO 27001: Information Security Standard for managing sensitive company data.
- General Data Protection Regulation (GDPR): European law on data protection and privacy.
- IEEE 830-1998: Recommended practices for Software Requirements Specifications.

13. Conclusion

The Integrated Land and Real Estate Digitalization and Fraud Prevention System will bring about a digital revolution in how land transactions are processed, audited, and managed. By leveraging AI and blockchain, the system will ensure transparency, reduce fraudulent activities, and provide citizens and government officials with a secure platform for managing land-related services.

With a detailed set of functional and non-functional requirements, along with robust security, performance, and scalability measures, this system will streamline land management processes and ensure compliance with national laws and regulations. The projected budget and timeline outline the system's implementation, ensuring delivery of a fully functional solution that will meet the needs of all stakeholders.

The vision of this project is not only to create a more transparent land management system but to lay the groundwork for a more accountable and digitally advanced governance infrastructure that will evolve and grow with future technological advancements.