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Project Title:NYAY-SETU: The Future of AI-Powered Digital Judiciary in India

TEAM NO.: 60

NAMES OF THE STUDENTS PARTICIPATED IN THE TEAM:
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DEPARTMENT: BCA - Computer Science
CITY: PUNE
STATE: MAHARASHTRA
PROJECT MENTOR NAME:
Vignesh Mathiyalagan

Project Details:

- Context: Nyay-Setu is a high-speed, sovereign judicial infrastructure designed to bridge the gap between litigants, lawyers, and judges by digitizing the entire legal lifecycle.
- Core Function: The platform integrates an AI-powered interface for natural language legal assistance and an immutable blockchain ledger for secure, decentralized evidence management.
- Vision: It serves as a digital bridge to provide immediate, immutable, and accessible truth for 1.4 billion people.

Problem Statement:

- The Judicial Crisis: Over 5.3 crore (53 million) cases are pending in Indian courts as of late 2025, with 85% of these cases stuck in District Courts.
- The Integrity Crisis: Physical paper files and centralized digital records are vulnerable to loss, corruption, or intentional tampering by malicious actors.
- The Communication Gap: Citizens often do not understand "Hard Legal Language," leading to legal anxiety and a dependency on scarce, expensive interpreters.

Need of Project:

1. Addressing the Administrative Crisis India currently faces a staggering backlog of over 5.3 crore pending cases. According to the National Judicial Data Grid, the current manual and clerical processes are insufficient to clear this mountain, leading to an "Inherited Battle" where litigants often pass away before their case is resolved.

Link: National Judicial Data Grid (NJDG)

2. Bridging the Economic & Travel Gap Research indicates that 15.6% of litigants must travel between 50km and 300km for a single, often 5-minute, hearing. This travel gap, combined with the loss of daily wages, makes justice an expensive luxury rather than a right. Nyay-Setu aligns with the e-Courts Phase III vision of "Justice from Home".

Link: e-Courts Phase III Vision Document

3. Combatting Judicial Exhaustion Judges spend nearly 2 hours daily on clerical tasks like manual case review and summoning. As highlighted in legal technology journals, there is an urgent need for "Blink-Speed" AI summarization (via Groq LPU) to recover this productivity and allow judges to focus on decision-making.

Link: LiveLaw: Technology as an Enabler for Indian Judiciary

4. Solving the Integrity Crisis Physical and centralized digital records are vulnerable to the "Tamper Game". Following international Blockchain Hashing Standards (SHA-256), there is a need for an immutable system where evidence cannot be altered by corrupt actors once deposited.

Link: DAKSH India: State of the Indian Judiciary

Proposed Solution: The Nyay-Setu Ecosystem

The Hybrid Framework Our solution, Nyay-Setu, is not a simple website but a sophisticated judicial ecosystem that integrates three distinct layers of technology to solve the "Case Mountain":

- **Vakil-Friend (AI Intelligence Layer): An LLM-powered assistant designed to simplify complex legal jargon for citizens and provide judges with "Blink-Speed" case summaries using Groq LPU hardware for near-instant inference.**
- **The Evidence Vault (Blockchain Trust Layer): A decentralized locker where every legal document is hashed using SHA-256 and anchored to a blockchain ledger, ensuring evidence is immutable and 100% tamper-proof.**
- **Virtual Litigant Hub (Communication Layer): A unified dashboard for lawyers and citizens that eliminates the "Travel Gap" by facilitating secure, remote document filing and case tracking.**

Technology Stack: The Industrial Blueprint

To ensure national scalability and judicial-grade security, Nyay-Setu utilizes a modern, modular architecture.

1. Core Development Stack

- Frontend: React 18 with Tailwind CSS for high-performance, responsive role-based dashboards that ensure accessibility for all users.
- Backend Orchestration: Spring Boot 3.2 utilizing Spring Security and JWT for secure, stateless authentication and enterprise-grade API management.
- Database Management: PostgreSQL 16 for ACID-compliant judicial records and transactional integrity.
- AI Inference Engine: Groq LPU (Llama-3-70B) for sub-second legal document processing, ensuring judicial productivity is not hindered by latency.

2. DevOps & Infrastructure

As a solo architect, implementing DevOps was critical for maintaining high availability and rapid deployment cycles:

- Version Control: GitHub served as the central repository for the "Source Code Sovereignty" of Nyay-Setu, managing all branch merging and code history.
- Deployment & Hosting:
  - Frontend: Deployed on Vercel for global CDN delivery and sub-second page loads.
  - Backend: Cloud-hosted instances optimized for Spring Boot's memory footprint.
- Continuous Integration (CI): Automated checks to ensure that the AI and Blockchain integration points remained stable during development.
- Monitoring: Integrated logs to track Groq LPU inference times and API response latencies.

3. Development Methodology

The project followed an Agile-Modular approach, allowing for the simultaneous development of the three core “Systems":

Phase 1: Foundation: Architecting the PostgreSQL schema and Spring Boot security layers.

Phase 2: Intelligence: Integrating the Groq LPU for Vakil-Friend and Judge-Summary features.

Phase 3: Integrity: Anchoring file uploads to the Blockchain via SHA-256 hashing standards.

Phase 4: Optimization: Final UI/UX polish and deployment to production environments.

Project Outcomes

1.Operational Efficiency & Productivity Recovery

- Blink-Speed Inference: By integrating the Groq LPU, the system achieved sub-second latency in generating case summaries and legal document audits, a task that previously took human clerks hours to perform.
- Clerical Automation: The platform successfully automates routine tasks such as case categorization and hearing scheduling, potentially recovering up to 2 hours of a judge's daily productivity.
- Role-Based Optimization: Custom dashboards for Citizens, Lawyers, and Judges ensure that each user has immediate access to their specific litigation data, reducing navigation friction.

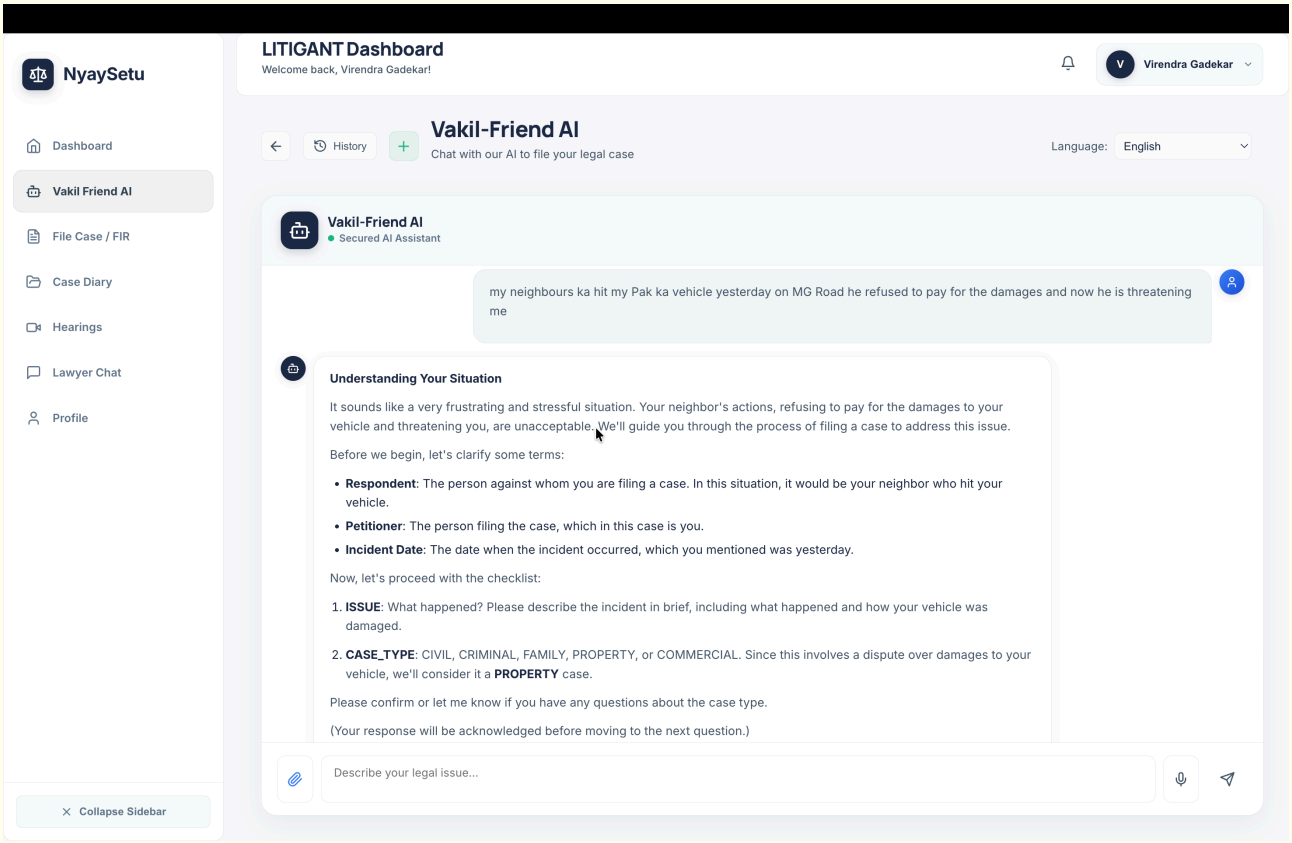
2. Zero-Trust Security & Data Integrity

- Immutable Evidence Locker: Utilizing SHA-256 cryptographic hashing, every piece of evidence uploaded to the platform is anchored to a Blockchain ledger.
- Tamper-Proof Verification: Once a document is hashed and stored, it becomes mathematically impossible to alter or delete the record without detection, effectively solving the "Tamper Game" in legal records.
- Secure Authentication: The use of Spring Security and JWT ensures that sensitive judicial data is only accessible to authorized personnel with the correct role-based permissions.

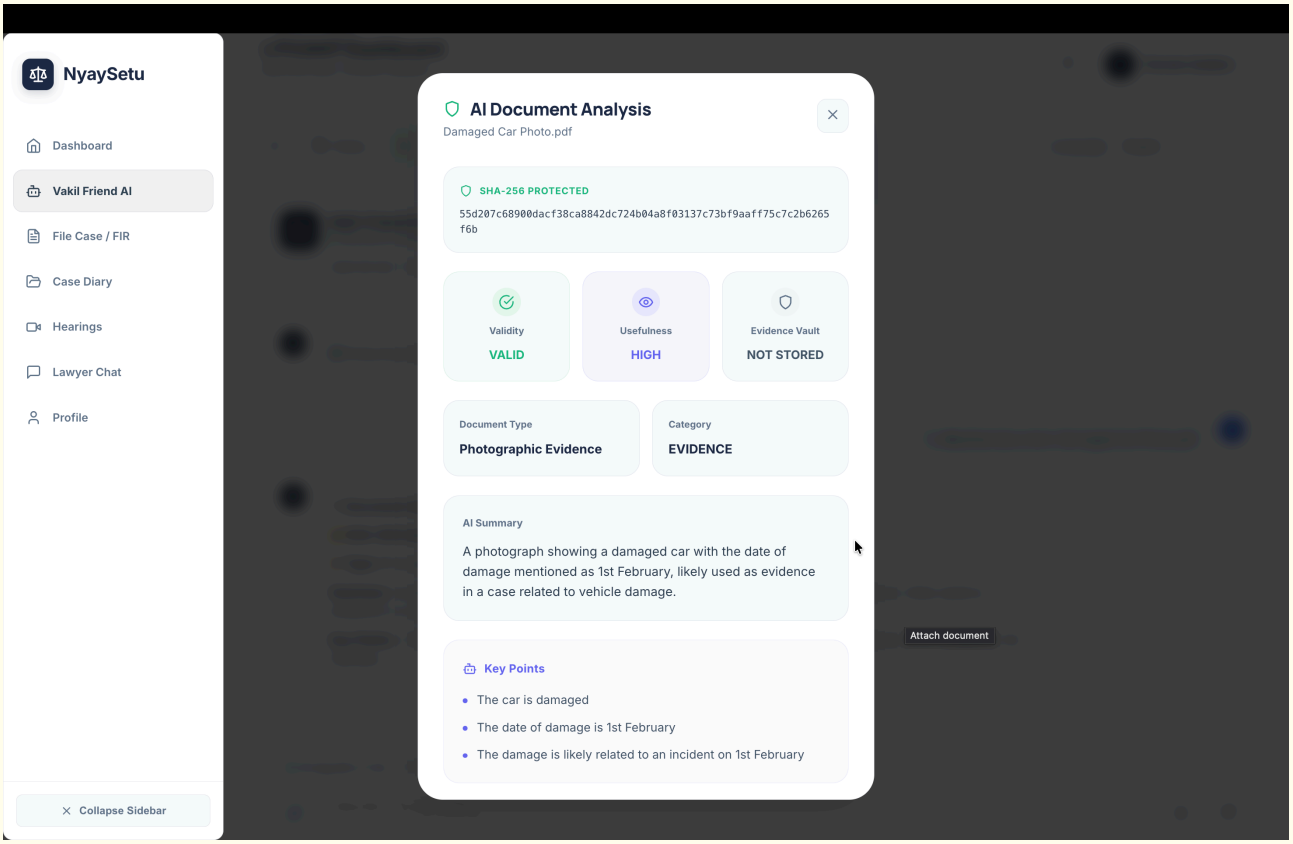
3. Social Inclusion & Accessibility

- Simplification of Law: The Vakil-Friend AI successfully translates complex "Hard Legal Language" into simple, actionable natural language, significantly reducing legal anxiety for common citizens.
- Bridging the Travel Gap: The platform provides a unified digital environment for remote case tracking and document filing, removing the economic burden for the 15.6% of litigants who otherwise have to travel over 50km for simple hearings.
- Institutional Alignment: The outcomes directly support the goals of the National e-Courts Mission Phase III, providing a scalable model for a paperless, digital-first judiciary.

Vakil-Friend AI: Interactive Case Filing Workflow



- **Natural Language Mapping:** The AI acts as a "Legal Translator," taking a user's raw story (e.g., "*my neighbor hit my car*") and identifying the legal components: **Petitioner**, **Respondent**, **Incident Date**, and **Issue**.
- **Dynamic Case Categorization:** As shown in your demo, the AI instantly classifies grievances into legal heads like **Property Dispute**, **Commercial Non-payment**, or **Civil Torts**, ensuring the filing starts in the correct judicial track.



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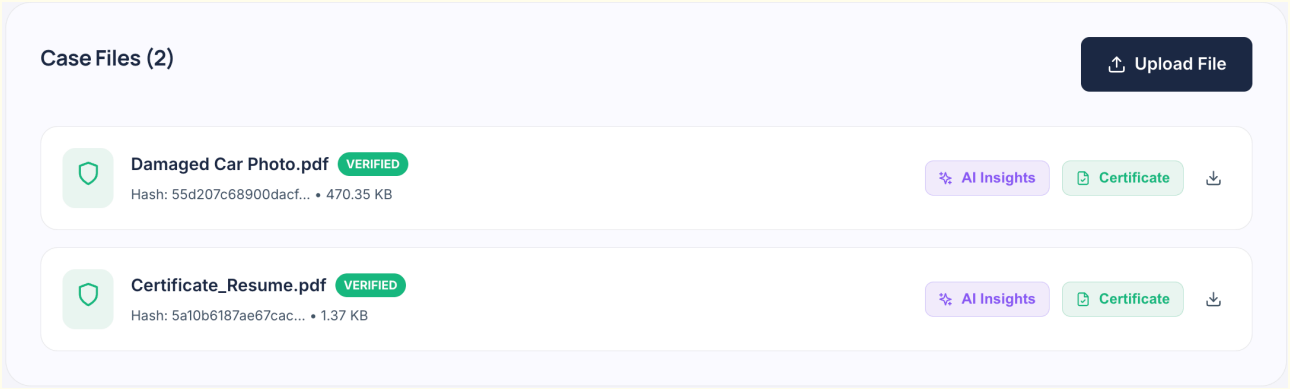
Title: Evidence Vault: The Foundation of Cryptographic Trust



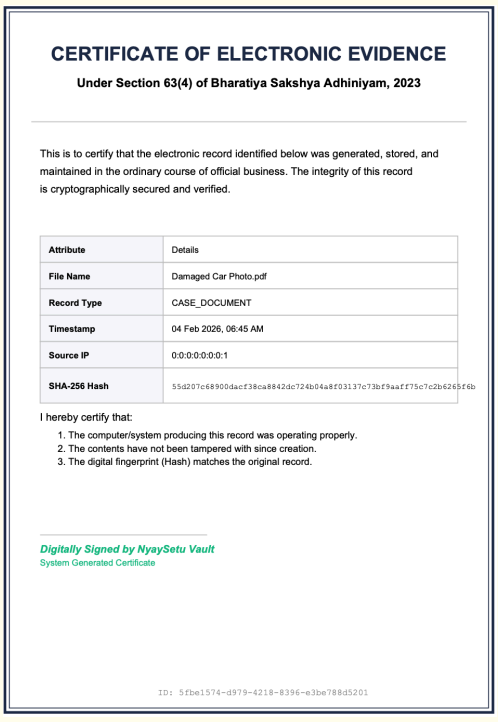
Overview: Solving the "Tamper Game" The Evidence Vault is the core integrity layer of the Nyay-Setu ecosystem. It transitions the judiciary from vulnerable physical files to a **Zero-Trust** digital environment. Every document uploaded is processed through a cryptographic pipeline that ensures judicial truth remains immutable for a lifetime.

Functional Features (As seen in the Evidence Manager UI)

- **SHA-256 Fingerprinting:** Every file (e.g., *Damaged Car Photo.pdf*) is instantly converted into a unique 64-character hash. This serves as a digital "DNA" for the evidence.
- **Real-Time Verification:** The "Verified" badge confirms that the current file matches the original record anchored to the blockchain. Any attempt to alter even a single pixel will break the hash and alert the judge.
- **AI-Audited Insights:** Beyond storage, the Groq-powered AI scans documents to extract critical facts, saving hours of manual review.

BSA Section 63(4) Automation

The standout innovation of Nyay-Setu is the automated generation of the Certificate of Electronic Evidence.



CERTIFICATE OF ELECTRONIC EVIDENCE

Under Section 63(4) of Bharatiya Sakshya Adhiniyam, 2023

This is to certify that the electronic record identified below was generated, stored, and maintained in the ordinary course of official business. The integrity of this record is cryptographically secured and verified.

Attribute	Details
File Name	Damaged Car Photo.pdf
Record Type	CASE_DOCUMENT
Timestamp	04 Feb 2026, 06:45 AM
Source IP	0:0:0:0:0:0:0:1
SHA-256 Hash	55d207c68900dacf38ca8842dc724b04a8f03137c73bf9aaff75c7c2b6265f6b

I hereby certify that:

1. The computer/system producing this record was operating properly.
2. The contents have not been tampered with since creation.
3. The digital fingerprint (Hash) matches the original record.

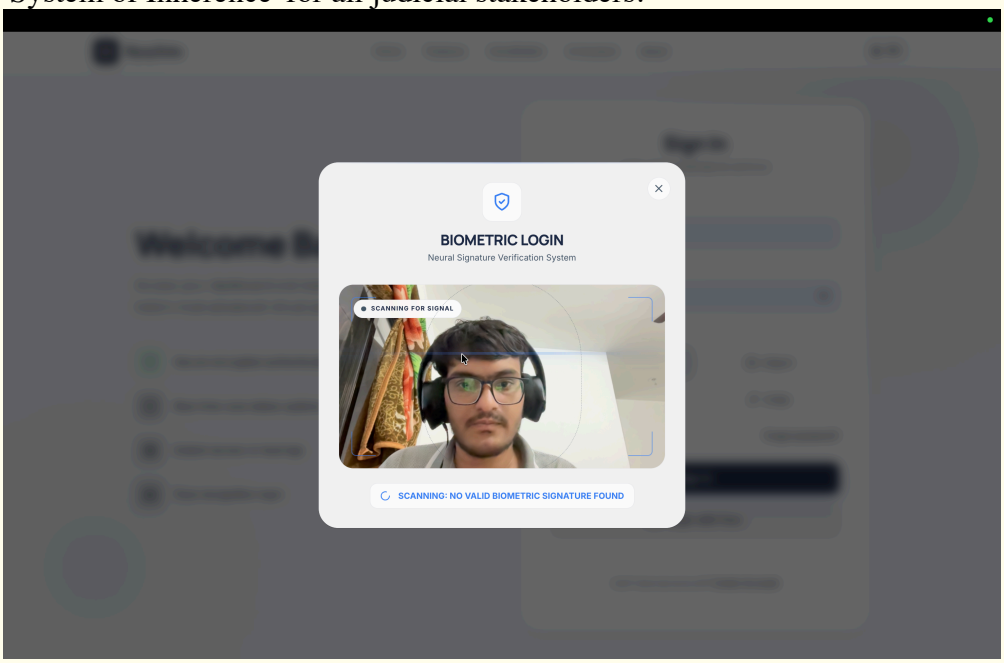
Digitally Signed by NyaySetu Vault

System Generated Certificate

ID: 5fbe1574-d979-4218-8396-e3be788d5201

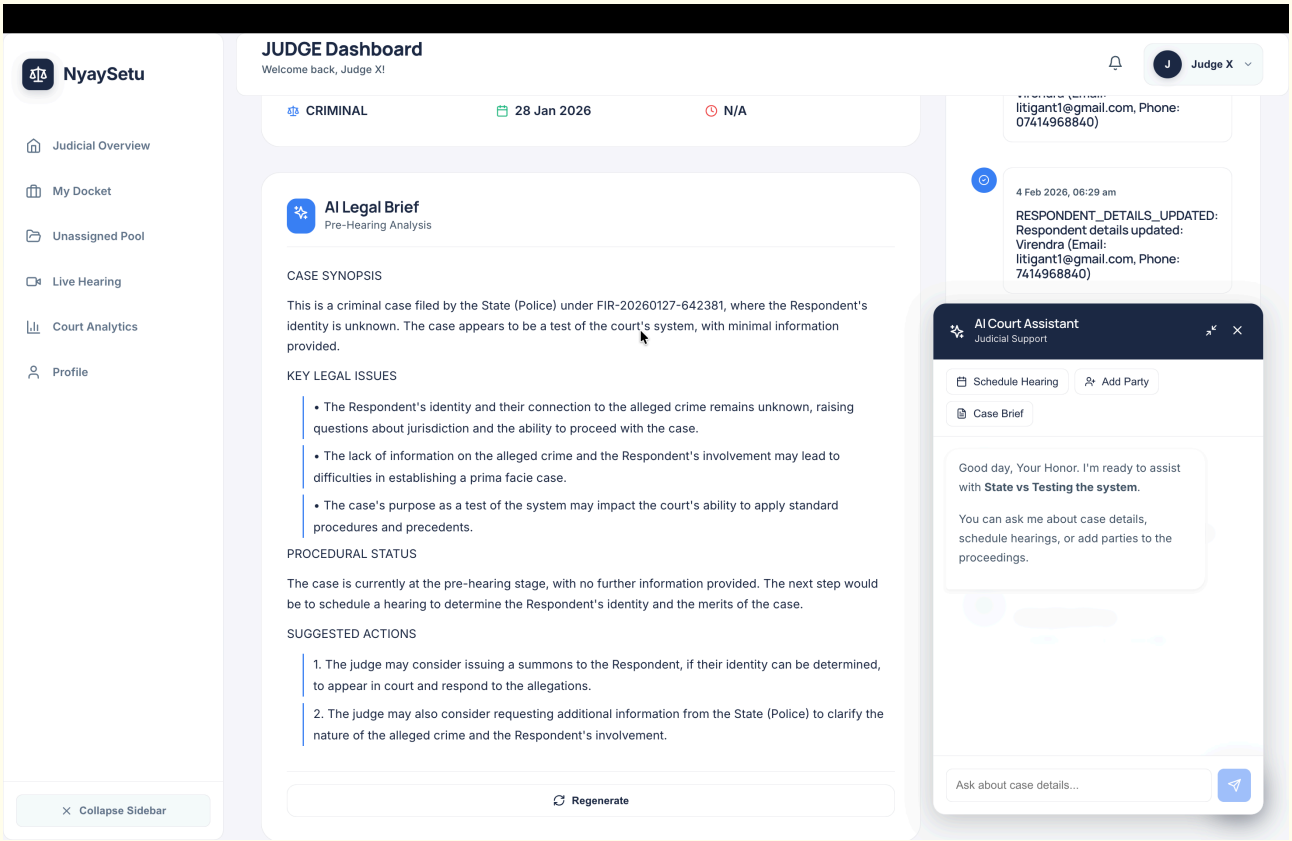
Biometric Login: Neural Signature Verification System

A password-less entry gate utilizing real-time facial authentication to replace vulnerable traditional systems with a secure 'System of Inherence' for all judicial stakeholders.

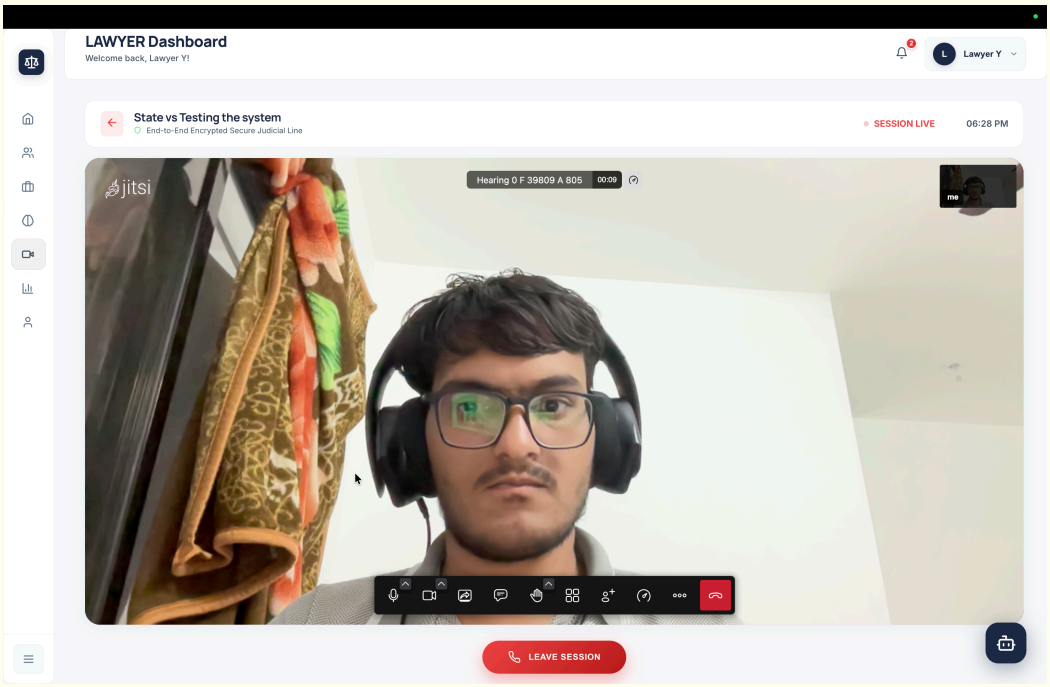


Judge AI: High-Velocity Decision Support

The Judge Dashboard integrates a Groq-powered AI engine that delivers near-instant 'Blink-Speed' summaries and synthetic legal briefs. By extracting the core legal essence and applicable statutes (BNS/BNSS) from voluminous filings, it reduces average case review time by up to 80%, allowing judges to focus on substantive decision-making rather than clerical review.

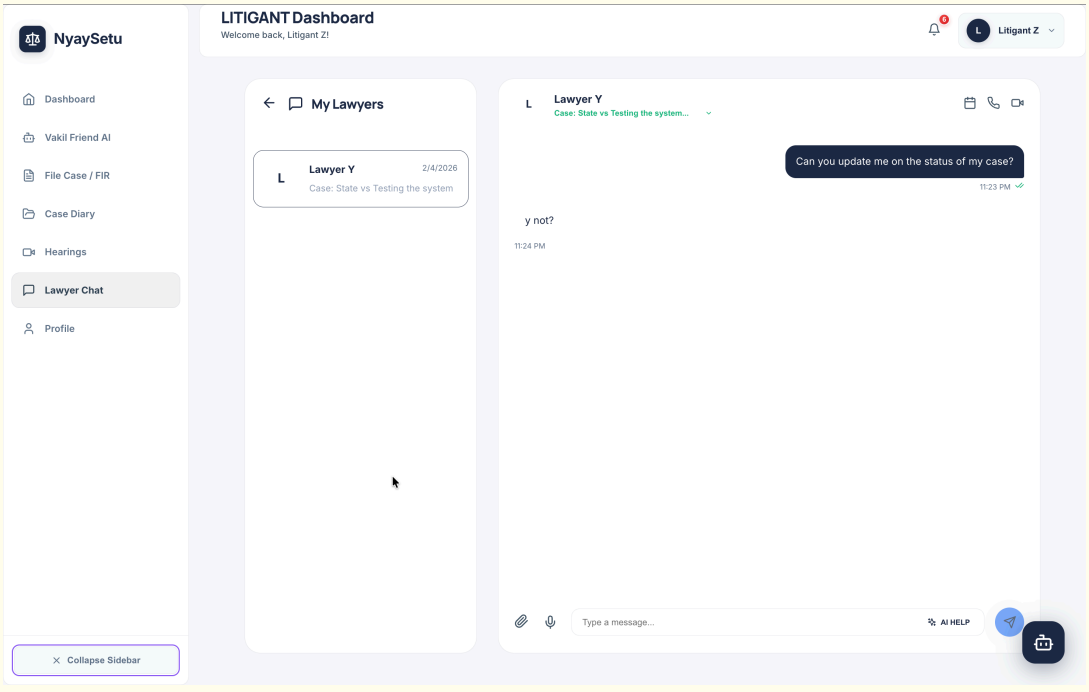


Virtual Courtroom: 5G-Powered 'Justice from Home



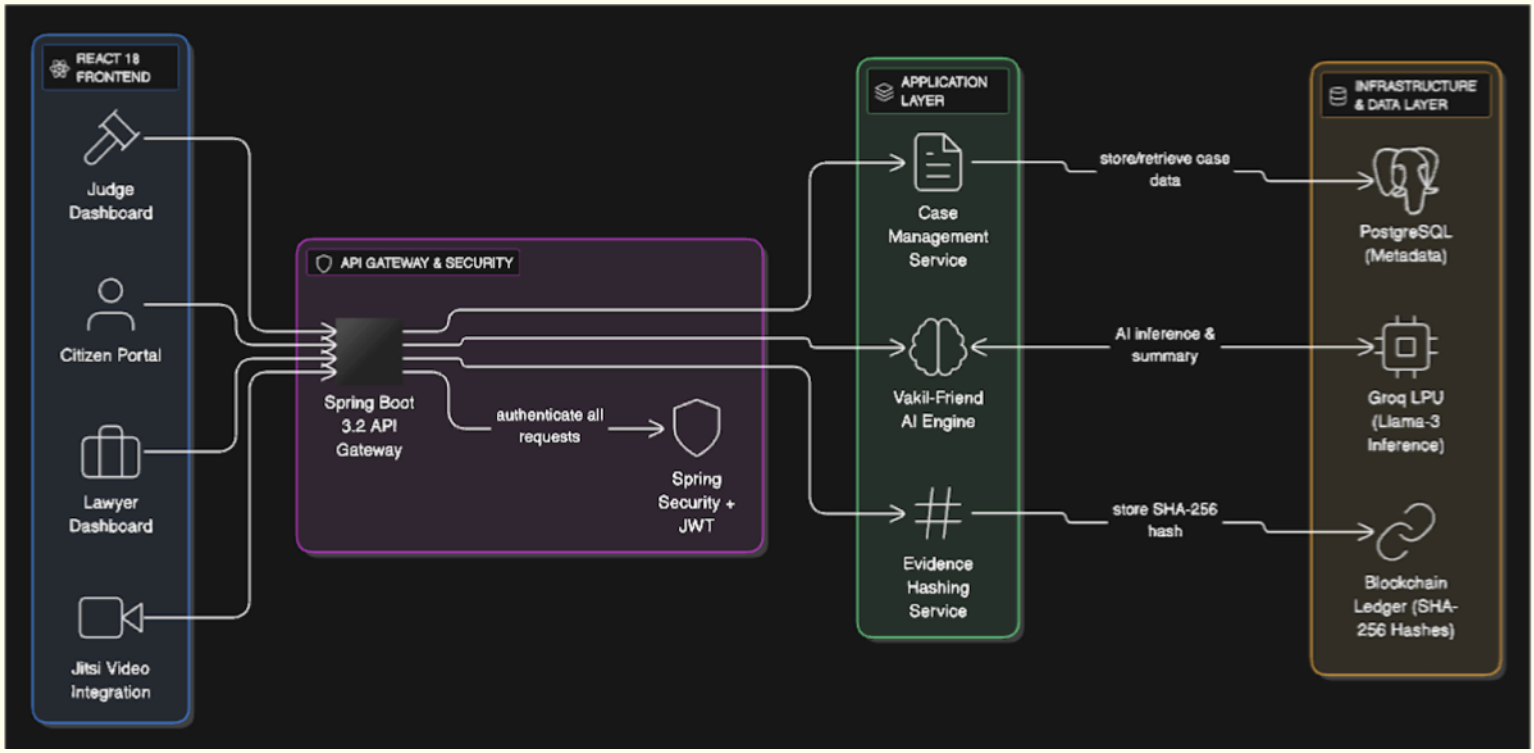
A high-definition, low-latency video interface integrated via **Jitsi**, designed for seamless remote adjudication. This module is fully **BNSS Section 530 compliant**, formalizing the use of audio-visual means for trials and inquiries in India. By utilizing **VOIS 5G Network Slicing**, the system establishes a 'Priority Lane' for courtrooms, ensuring zero-lag communication and Full-HD clarity even in high-congestion environments, effectively erasing the 100km travel gap for rural litigants.

Collaborative Hub: Secure Lawyer-Client Messaging



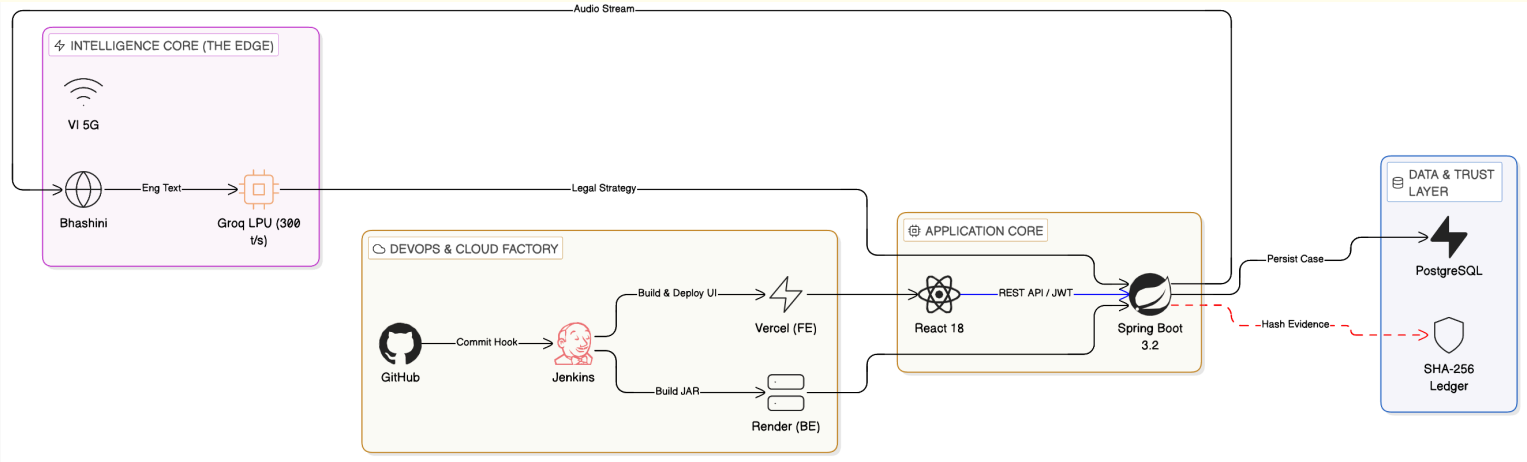
A secure, end-to-end encrypted channel that serves as the 'Virtual Office' for legal strategy. It eliminates 'Legal Anxiety' by providing citizens with direct, real-time access to their legal counsel. The chat interface features an **'AI-Help' assistant** that can instantly simplify a lawyer's complex updates into everyday language, ensuring the litigant is always empowered and informed.

Section: Technical Flow & Architecture



Overview The **Nyay-Setu** technical flow is an enterprise-grade, role-based architecture designed for high-concurrency judicial operations. It uses a decoupled, four-layer strategy to ensure that security, intelligence, and data integrity are handled by specialized services.

Section: Modelling – The Three-Zone Strategy



- The project modeling is structured into three specialized environments to maintain a "System of Record, Speed, and Trust":

Zone 1: The Transactional Core (System of Record)

- Using **PostgreSQL 16**, this zone ensures relational integrity and ACID compliance for core case metadata, user profiles, and real-time hearing schedules.

Zone 2: The Intelligence Engine (System of Speed)

- To solve the crisis of judicial exhaustion, this zone utilizes the **Groq LPU (Llama-3 inference)**. It is optimized for matrix mathematics and sub-second latency, converting raw text into generated AI summaries and tags in an ephemeral vector context without taxing the primary database.

Zone 3: The Immutable Anchor (System of Trust)

- The final modeling layer is the **Blockchain Ledger**. This zone stores the **SHA-256 Hash Deposits**, creating a decentralized verification chain where data cannot be altered. These tamper-proof hashes are then delivered directly to the **Judge's Secure Dashboard** for absolute verification.

- **Section: Future Scope – The Roadmap to 2026**

This section proves that Nyay-Setu is a long-term infrastructure project, not just a hackathon prototype.

Horizon 1: Technical Sovereignty (Short Term):

Aadhaar-Based e-Sign: Integrating legally binding digital signatures for every petition to replace simple uploads.

Predictive Analytics: Using the AI Brain to predict judicial resource needs based on regional case-flow trends.

Horizon 2: National Scalability (Medium Term):

Indic-Language LLMs: Expanding Vakil-Friend to support all 22 official Indian languages.

Interoperable Justice: Connecting Nyay-Setu to Police (CCTNS) and Prison (e-Prisons) databases for a seamless information flow.

Horizon 3: The AI Frontier (Long Term):

Sentencing Consistency Engine: Providing judges with AI-driven historical data to ensure uniform sentencing for similar crimes.

Smart Contracts for Civil Disputes: Using Blockchain Smart Contracts to automate settlemen execution and reduce post-judgment litigation.

NyaySetu operates on a Tri-Sector Revenue Model, targeting the three primary stakeholders of the Indian legal ecosystem: Citizens, Legal Professionals, and the Government. By diversifying income streams, the platform ensures sustainability while maintaining its core mission of accessible justice.

1. B2C: The Freemium Legal Aid Model

- This model focuses on high-volume user acquisition by lowering the entry barrier for common citizens.
- The "Free" Tier (Market Penetration): Users access basic legal rights education, a bilingual legal dictionary, and a real-time case status tracker. This builds a massive user base and establishes Vakil-Friend as a trusted household name.
- The "Premium" Tier (Monetization):
  - o AI Document Drafting: Charging a flat fee (e.g., ₹199 - ₹499) for generating legally valid notices, rent agreements, or affidavits.
  - o Evidence Analysis: A "Pay-per-Analysis" model where the Groq-powered AI scans large volumes of chats/documents to extract critical evidence points for a small fee.
  - o Direct Connect: A convenience fee for instant 15-minute video consultations with verified lawyers.

Expected Revenue : 530,000 users × ₹299 = **₹**15.8 Crore Projected Revenue

2. B2B: The Lawyer's "Virtual Office" (SaaS)

- Lawyers represent the primary recurring revenue source for the platform. NyaySetu acts as their digital headquarters.
- Subscription Model (Software as a Service): Lawyers pay a monthly or annual fee (e.g., ₹999/month) to access:
  - o AI Case Summaries: Saving hours of manual reading.
  - o Digital Evidence Locker: Secure, organized cloud storage for all their active files.
  - o Automated Diary: Auto-syncing with High Court/District Court websites for automated hearing reminders.
- Marketplace Commission: A "Lead Generation" fee or a small percentage commission on hiring transactions made through the platform's marketplace.

Expected Revenue - 20,000 Lawyer × ₹999 = ₹1.99 Crore MRR(Monthly Recurring Revenue)

3. B2G: Strategic Government Partnerships

Given the ₹7,210 Crore e-Courts Phase III mandate, B2G represents the highest revenue potential.

- Infrastructure Licensing: Licensing the "Judicial Efficiency Flow" and "Case Pooling" modules to State Legal Service Authorities (SLSAs) for managing Lok Adalats and small claims.
- E-Sewa Kendra Integration: Providing the bilingual AI interface for government-run kiosks in rural areas under a service-level agreement (SLA).
- E-Filing Convenience Fees: If authorized as a digital filing partner, charging a nominal "processing fee" (e.g., ₹10–₹20) per document upload for maintaining the immutable blockchain anchored evidence locker

- Official Mission Budget: [Cabinet Approves ₹7,210 Crore for e-Courts Phase III]
- Vision Document: [e-Committee, Supreme Court of India - Phase III Roadmap]

Budget Pillar	Amount	NyaySetu Opportunity
Digitization	₹2,038 Cr	Using Groq LPUs to OCR and summarize 3,108 crore pages of legacy records.
e-Sewa Kendras	₹394 Cr	Your bilingual AI can act as the "Digital Clerk" at 4,400+ village kiosks.
Future Tech/AI	₹53.5 Cr	Tapping into specific funds for "Intelligent Scheduling" and "Case Forecasting."

4. Cost-Efficiency & Profitability Analysis

- Low Marginal Cost: By using Groq LPUs, the cost of processing a single AI legal query is significantly lower than traditional GPU-based cloud models, allowing for high profit margins on AI services.
- Scalability: The Spring Boot/PostgreSQL architecture allows the platform to scale from1,000 to 1,000,000 users without a linear increase in operational costs.
- Retention: The "Virtual Office" tools create high "stickiness" for lawyers, ensuring stable, recurring monthly revenue.

Governance, Ethics & Responsible Deployment

1. Clear System Boundaries (What Nyay-Setu Will NOT Automate)

- Nyay-Setu **does NOT replace judges or lawyers** and will never generate verdicts or judicial orders autonomously.
- AI outputs are **advisory only**, designed to assist comprehension, not decision-making.
- Final authority for **judgments, sentencing, and legal interpretation** always remains with human judges.
- Sensitive matters (criminal sentencing, constitutional interpretation) are **explicitly excluded** from automation.

Principle: AI assists justice — it never delivers justice.

2. Ethics & AI Guardrails (Bias, Privacy & Trust)

- **Human-in-the-Loop**: Every AI-generated summary or suggestion requires explicit human review before use.
- **Bias Prevention**:
  - No training on live or sensitive judicial data.
  - Model outputs are constrained to summarization and classification, not prediction of guilt or punishment.
- **Privacy-First Design**:
  - No biometric images are stored; only encrypted verification signals are used.
  - Evidence hashes are stored on blockchain — **not the raw documents**.
- **Explainability**:
  - Judges can trace AI summaries back to original source documents at any time.

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Section: Project Infrastructure (Final Links)

The Architect's Proof To ensure full transparency and technical sovereignty, the complete ecosystem of Nyay-Setu is accessible for review, audit, and live testing.

- **GitHub Repository (Source Code):**

https://github.com/viru0909-dev/nyay-setu-working

Note: This repository contains the complete Spring Boot 3.2 backend logic, the React 18 frontend dashboards, and the integration scripts for Groq LPU and Blockchain anchoring.

- **Live Platform Access (Production):**

https://nyaysetu-lovat.vercel.app/

Note: This is a high-availability environment hosted on Vercel, optimized for sub-second latency and live judicial simulations.

Team Members:

- **Virendra Gadekar (Lead) -**

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