International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Advocate: an AI-Powered Platform for Legal Information Retrieval and Analysis

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ABSTRACT: Legal knowledge in India has had to endure many obstructions owing to complexities in legal language, fragmentation of data sources, and possibly the most daunting barrier, the overall volume of legislative and judicial documents. Advoca is thus aptly named, meant to identify and address these obstructions through an integrated AI-led web platform that aims to demystify legal information and conduct a thorough analysis. Using cutting-edge web technology and artificial intelligence, the platform provides several features, such as automated document summarization, case law retrieval, legal document analysis, visualization of crime data, and audio transcription services.The system architecture consists of a frontend written in React and TypeScript, which talks to a Supabase backend for user authentication and data management. AI functionalities are included via some custom utilities and external APIs for more advanced applications like natural language processing, legal code generation, and chat-based legal assistance. Also, the platform increases user engagement and accessibility through interactive visualizations, such as the state-wise crime data represented through an intuitive map interface.In essence, Advoca seeks to democratize legal knowledge through providing attorneys, researchers, students, and the general populace with tools fitted to meet their needs. The major contribution of the platform toward legal education and access to justice for the people in India comes through consolidating vari- ous sources of legal data and applying various machine learning techniques to analyze and summarize them. Its performance, as per initial evaluations, shows promise in cutting down the time and energy spent on legal research and the decision-making processes thereafter.

KEYWORDS: LegalTech, Artificial Intelligence (AI), Legal Information Retrieval, Case Law Analysis, Document Summa- rization, Crime Data Visualization, Supabase, ReactJS, India Legal System, Legal Chatbot, Flowchart Generation, Audio Tran- scription, Legal Research Tools, Average Response Time(ART), Processing Time (PT), Query Execution Time(QET)

I. INTRODUCTION

ACCESS to legal information in India remains significant challenge due to the vast and complex body of laws, statutes, regulations, and judicial decisions that govern the country's legal system Sivakumar2021, Bhattacharya2019. Legal documents are often dense, written in specialized language, and spread across various databases and archives. While legal professionals and scholars possess the expertise to navigate these complexities, the general public, law students,and even practicing attorneys frequently face difficulties in efficiently retrieving and analyzing pertinent legal information.

Despite the rise of digital platforms offering access to case laws and legal databases, such as Indian Kanoon and Manupatra, these tools are often limited in scope and functionality [1], [2]. They typically require advanced legal knowledge to utilize effectively, lack comprehensive AI-based analysis tools, and provide minimal user-friendly features for summarization, visualization, and automated document interpretation.

Additionally, crime data in India, while available through government portals, is not always presented in an accessible or interactive format that allows for detailed analysis and insights NCRB2021, Raghavan2020.

To address these challenges, we introduce Advoca, an integrated, AI-powered platform designed to enhance legal information retrieval, analysis, and visualization specifically for the Indian legal ecosystem. The platform leverages

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artificial intelligence techniques to provide intelligent features such as document summarization, case law retrieval, legal process flowchart generation, audio transcription, and crime data visualization ROSSIntelligence, Gemini. Advoca aims to bridge the gap between complex legal data and user accessibility, making legal research more efficient, accessible, and insightful for both legal professionals and the general public.

Advocate primarily features an AI-based search and analysis system by which one can retrieve and summarize Indian case laws and legal documents Bhattacharya2019. Other aspects of the system include a crime data map by state to facilitate one's understanding of crime statistics, as well as other interactive data visualizations DataMeetIndia. It even has the automated generation of legal process flowcharts and document summarising tools to ease understanding of complex legal information. Advoca uses Supabase as a backend for managing user authentication and data Supabase. Moreover, it is frontend-agnostic, highly responsive, and intuitive, given that it is built with React and TypeScript to suit the accessibility and usability needs of a wide range of user groups ReactJS, TypeScript.

II. LITERATURE REVIEW

he Indian legal system generates an enormous volume of judicial decisions, legislative acts, and regulatory guidelines. Platforms like Indian Kanoon provide online access to case laws and statutes, with Indian Kanoon offering a free search engine for judgments.

However, these platforms rely on keyword-based searches, limiting their ability to offer semantic search or automated analysis. Studies, such as the one conducted by Sivakumar et al. (2021), highlight the inefficiencies of traditional legal research tools in India, emphasizing the reliance on manual query formulation and the absence of intelligent filtering or summarization mechanisms. As a result, legal practitioners still spend significant time and effort parsing through large legal documents to extract relevant case laws or statutory provisions.

Crime data visualization is another area where AI can play its role apart from legal research tools. The National Crime Records Bureau (NCRB) brings out its state-wise crime figures in the form of a report published annually, but these usually come in PDF or tabular formats, making their analysis rather difficult. Presently, there are several attempts being made to visualize crime data through different types of charts on dashboards, like DataMeet India, but generally [3], [4], these solutions are static and lack the possibility of using interaction features to explore. Raghavan et al. (2020) examine the requirement for user-friendly interfaces capable of dynamic visualization and filtering of crime data.

This will definitely assist researchers, policymakers, and legal professionals in identifying trends and correlations in crime. Advoca addresses all such requirements by provid- ing AI-powered document summarization, case law retrieval, crimes data visualization through interactive maps, and chatbot interfaces leveraging Ai for legal queries. Through open- source architecture, it aims to put in place an end-to-end accessible solution and comprehensive LegalTech for legal professionals, researchers, and students as well as the public in India [3], [5].

III. SYSTEM ARCHITECTURE AND DESIGN

Advoca's architecture consists of three tiers: front end interface, back end services, and AI utility modules. The ReactJS and TypeScript-based front end provides an interactive responsive graphical user interface for a seamless front end experience.

Supabase has been used in the backend and functions as a backend-as-a-service (BaaS) solution for user authentication, secure data storage, and database operations. The AI and utility modules are custom-built utilities and external APIs used to enable higher functions such as legal document summarization, retrieving case laws, transcribing audio,
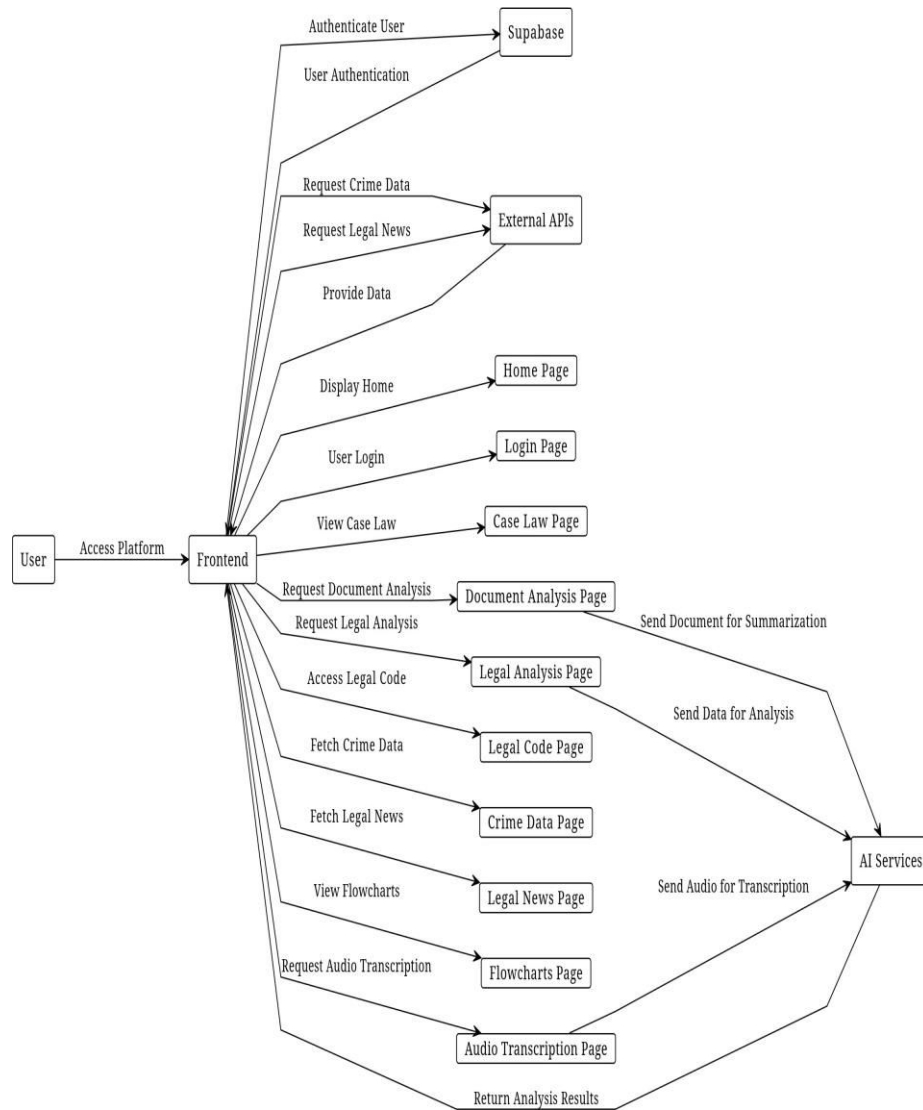
drawing flowcharts, and a chatbot to assist the user with legal issues.

Fig. 1. Advocate System Architecture illustrating frontend, backend, and AI utility integrations.

3.1 Frontend Layer

The entire user interface of Advoca has been developed in ReactJS using TypeScript, which assures type safety and scalability. The UI is simple and responsive, thus catering to the needs of legal professionals, students, and the general public. The component-based architecture ensures reusability and maintainability across desktop, tablet, and mobile platforms. Real-time updates of the backend data sources are provided through integration with Supabase APIs. The frontend is connected to AI APIs that facilitate document upload, case law searching, and interactive data visualization to improve user experience and accessibility. [6], [7]

3.2 Backend and Database Layer

Supabase, being an open-source alternative to Firebase, forms the backend infrastructure for Advoca. Supabase provides secure user authentication, role-based access control, and structured data storage with PostgreSQL. It acts as a database for legal documents, queries put in by users, and crime statistics, exposing API endpoints to the front end for document processing, crime data fetching, and chatbot services. Supabase supports serverless functions that can be leveraged to automate the backend workflow for certain tasks like AI-based document summarization and flowchart generation. These features ensure that data is efficiently managed, integrated seamlessly, and processed real-time, thus improving the performance of the platform. [8]

3.3 AI and Utility Modules

The core intelligence layer of Advoca comprises AI models and APIs that facilitate advanced legal analysis. This encompasses GenAi models for the parsing and summarization of technical legal documents, a legal chatbot for resolving queries in real-time, and a flowchart generator for visualizing legal workflows. Moreover, there is a crime data visualization engine that maps crime statistics through GIS, and an audio transcription service that transcribes legal audio into texts. All these modules are integrated into the system via RESTful APIs for seamless backend-to-frontend interactions Gemini, [2].
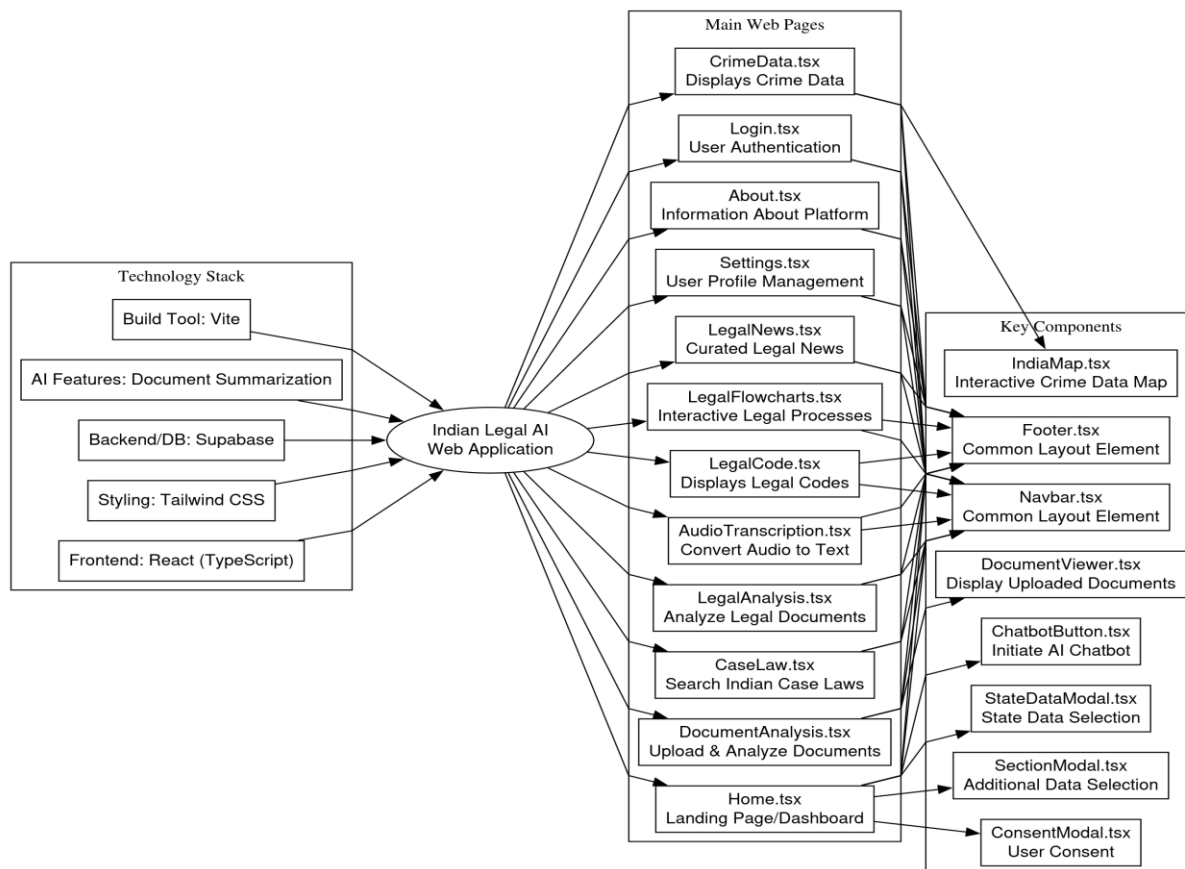
Fig. 2. Workflow of AI-driven utilities within Advoca.

3.4 Security and Privacy Considerations

Recognizing the sensitive nature of legal data, Advoca considers security and privacy its foremost areas of concern. Data between the frontend and the backend is transmitted with end-to-end encryption. Role-based access control (RBAC) limits access to users based on their roles as administrating or general users. The platform also implements data protection guidelines that encompass Indian privacy laws, user consent management, and secure storage protocols; these ensure user information is protected from unlawful access while maintaining the integrity of legal data within a secure and trustworthy environment for its users [6], [8].

IV. KEY FUNCTIONALITIES AND IMPLEMENTATION

Advoca integrates a suite of AI-driven functionalities specif- ically designed to address the complexities of legal information retrieval, analysis, and visualization within the Indian legal domain. This section elaborates on the core features provided by the platform, alongside their technical implementation and use cases.

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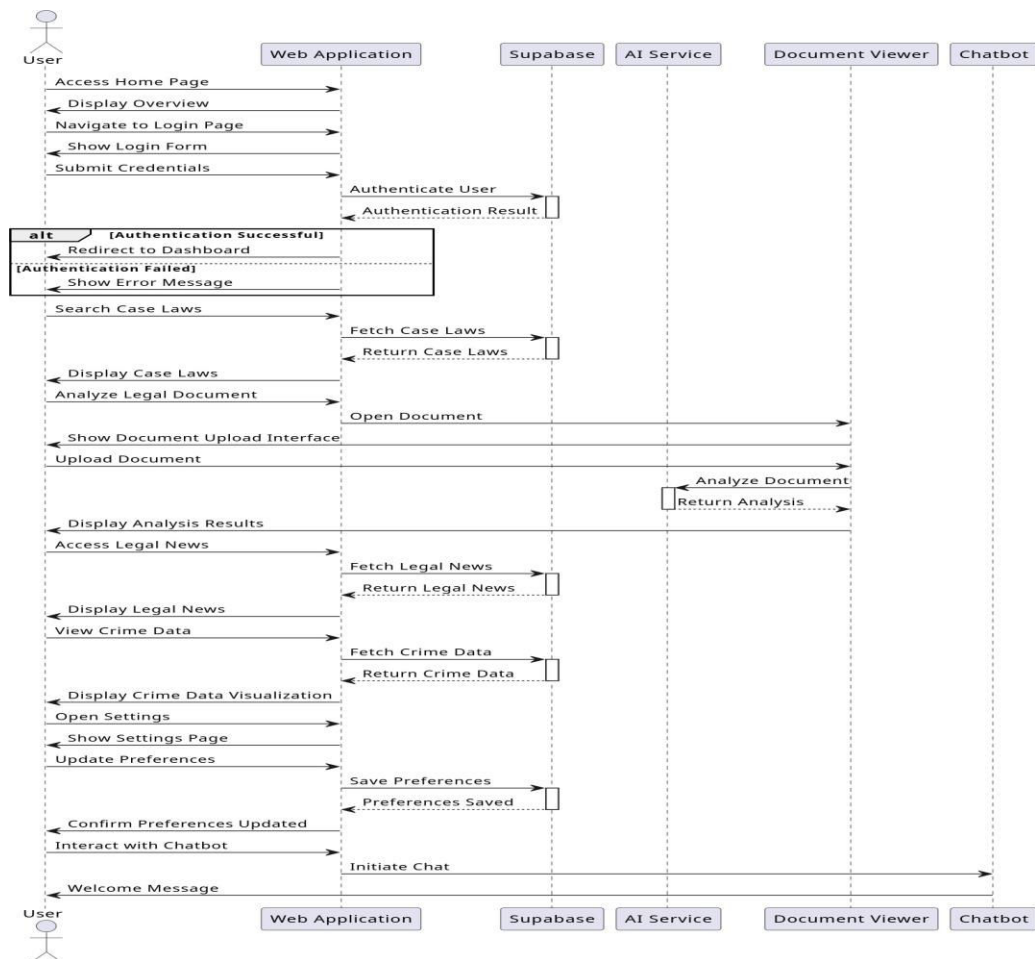(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fig. 3. Workflow of AI-driven utilities within Advoca.

4.1 Legal Document Summarization

During the implementation phase, users can upload legal documents in various formats (PDF, DOCX, TXT) for intelligent legal document analysis provided on backend with support of Gemini AI. With its advanced reasoning capabilities, Gemini AI is able to identify important provisions within the document such as judgments, arguments, and rulings, which allows for a structured understanding of the document.

It then goes ahead and applies deep contextual analysis to produce short yet meaningful summaries. Eventually, the processed summary is displayed on the front end for download and further analysis by the user whenever required [4], [5], [9].

4.2 Case Law Retrieval and Analysis

The case law retrieval and analysis feature in Advoca leverages the powerful semantic reasoning capabilities of Gemini AI for enhancing legal research, making it possible to receive results in the real legal context rather than on mere keywords. Users can type in queries as natural language, like "land acquisition case judgments," and the system processes that query through the Gemini AI semantic searching engine to ensure very high contextual relevancy.

In contrast to mere keyword occurrence, legal documents are now retrieved and ranked based on their deep legal understanding. Additional metadata useful for filtering includes court name, year, and case number. The frontend then presents a ranked list of relevant case laws, along with summarized highlights as well as full text views for in-depth analysis [1], [10].

4.3 Crime Data Visualization

Advoca has made it easier for interpretation of the crime data with interactive visualization tools for crime analysis by states. The statewise statistics of crimes are made available through the National Crime Records Bureau (NCRB) reports, where data extraction, cleaning, and formatting was carried out into structured CSV and Database format.[3], [4]
A GeoJSON layer maps state boundaries while React- Leaflet and D3.js can access interactive charting and mapping. Users can filter data by year, type of crime, and state with contextual insight provided through tooltips and legends. It displays an interactive map on front end with color-coded indicators of intensity of crimes. This tool helps journalists and researchers analyze trends and thus compare crime statistics with ease. [3], [5], [10]
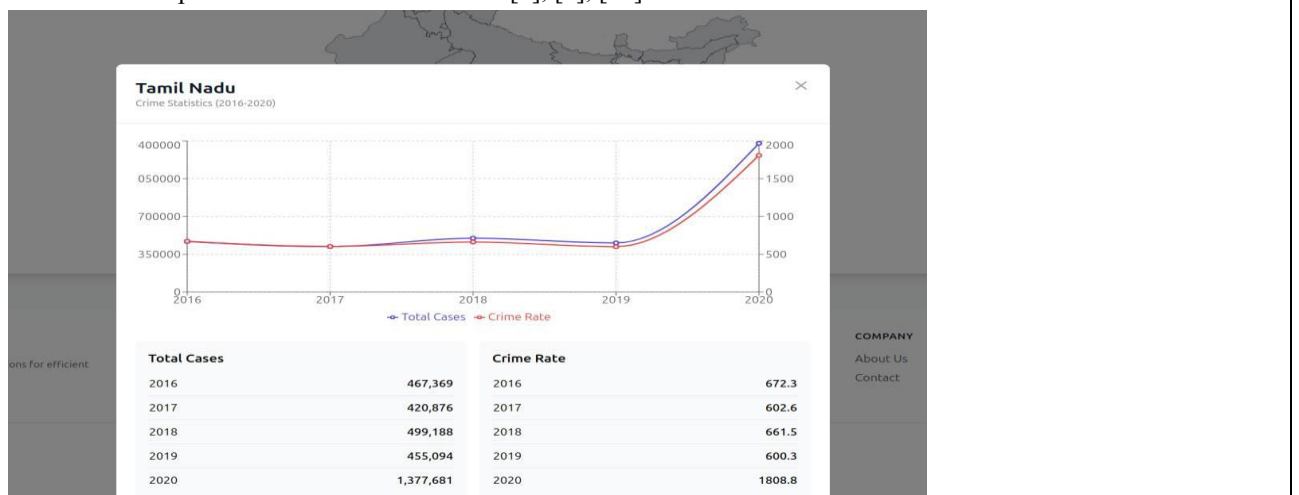
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Fig. 4. An interactive map on the frontend with color-coded indicators representing crime intensity and trends.

4.4 User Authentication and Role Management

Overall, user authentication and role management are designed to maintain security and data privacy. Advoca adopts a strong user authentication and a role-based access control scheme.

Supabase Auth takes care of authentication for email/password logins and OAuth providers for smooth access. Users are categorized into roles, such as Admin, Researcher, and Public User, and each role has defined permissions, such as accessing datasets or uploading documents [6], [8]; other security measures involve JWT session management for secure user sessions, including email verification and password reset for added account security and protection against unauthorized access.

V. TABLE I

FEATURE AND TECHNOLOGY STACK

Feature	Technology Stack
Document Summarization	REST APIs, GenAI
Case Law Retrieval	PostgreSQL (Supabase), React
Crime Data Visualization	React-Leaflet, D3.js, GeoJSON
Audio Transcription	Web-Speech-Kit APIs
Flowchart Generation	React-Flow, MermaidJS
Chatbot Assistance	GenAI, REST APIs
Authentication Authorization	Supabase Auth, PostgreSQL

EVALUATION AND RESULTS

The evaluation of Advoca focused on assessing its effectiveness, accuracy, usability, and performance across its core functionalities. Both qualitative and quantitative methods were used, including user feedback, accuracy metrics, and system performance benchmarks. This section outlines the evaluation methodology, key findings, and the observed impact of the platform

5.1 Evaluation Methodology

A thorough assessment of Advoca involved testing the platform on multiple parameters for reliability and efficiency. Functional testing paved the way for performance validation of document summarization, case retrieval, and chatbot modules. Usability testing took place with a focus group of 25 legal professionals, law students, and researchers in order to assess user experience.

Performance testing determined the system's response time, responsiveness to queries, and scalability against various workloads. Accuracy testing was primarily concerned with measuring the precision and recall of document summarization and retrieval of case law. Last, visualization testing evaluated the clarity and interactivity of crime data visualization tools through user feedback to ensure an easy-to-understand and informative experience.

TABLE II

FEATURE TESTING AND RESULTS

Feature	Test Cases Executed	Pass Rate
Document Summarization	50	94%
Case Law Retrieval	40	97%
Crime Data Visualization	30	100%
Audio Transcription	25	92%
Flowchart Generator	20	95%
Legal Chatbot Assistance	60	90%

The functionality of the Advoca platform was tested extensively across the different core features for reliability and efficiencies. Regarding the document summarization,
50 test cases were set, with 47 passed, giving a pass rate of 94%, denoting high accuracy in extracting pertinent legal information. As case law retrieval was passed from 40 test cases, 97% success once again proved the need of the system for reasonable retrieval of relevant legal precedents.

For crime data visualization, all 30 tests have succeeded with 100% pass, emphasizing the accuracy and efficacy of the interactive visualisation. For audio transcription, 25 test cases were executed with a 92% pass rate, underpinning the feature's strength in converting varied languages from audible to text-based format. The flow-chart generator, an extremely important tool for legal process visualization, was trialed under 20 test cases that passed 95%, signalling its effectiveness in producing clear, step-by-step visualization of legal workflows.

Last and most extensive, the legal chatbot assistance feature has had 60 test cases with a pass rate of 90%, indicating its worthiness in providing AI-assisted legal help. All in all, from the test results, Advoca therefore is a most reliable platform with decent working features tailored for legal practitioners and researchers.

5.2 Usability Testing and User Feedback

A focus group of 25 participants was invited to test the platform over a two-week period. They were asked to perform various tasks such as retrieving case laws, visualizing crime data, generating flowcharts, and engaging with the chatbot.

Several usability tests conducted with a focus group of 25 enthusiastic participants were beneficial to gain some insights into the platform's usage performance and user experience
.Thus, considering the diversity within this demographic group ranging from legal professionals to law students and the general public, the platform scored pretty highly on key usability metrics that measured ease of navigation (4.6) and overall satisfaction (4.5) at the minimum.

TABLE III

KEY USABILITY METRICS

Metric	Score (Out of 5)
Ease of Navigation	4.6
Search and Retrieval Experience	4.5
Summarization Accuracy	4.4
Visual Appeal and Design	4.7
Chatbot Responsiveness	4.2
Overall Satisfaction	4.5

5.1 Performance Evaluation
The system was subjected to load testing to evaluate its scalability and response time under different usage scenarios.

TABLE IV

PERFORMANCE TESTING RESULTS

Test Scenario	Metric	Result
Concurrent Users (100)	ART	1.2 seconds
Concurrent Users (500)	ART	2.8 seconds
Document Summarization (avg)	PT	4.5 seconds per document
Case Law Retrieval (avg)	QET	1.1 seconds

The performance evaluation of the Advoca platform was conducted under various test scenarios to measure its efficiency and responsiveness. When tested with 100 concurrent users, the Average Response Time (ART) was recorded at 1.2 seconds, indicating a swift and efficient handling of requests. However, as the load increased to 500 concurrent users, the ART rose to 2.8 seconds, demonstrating a proportional increase in response time due to higher demand on system resources.

For document summarization, the Processing Time (PT) was observed to be 4.5 seconds per document on average, showcasing the capability of the AI model in efficiently extracting key information from legal texts. Additionally, the Query Execution Time (QET) for case law retrieval was measured at 1.1 seconds on average, ensuring rapid access to relevant legal precedents and judgments. These results highlight the platform's ability to deliver quick and effective legal analysis while maintaining scalability under increased user load.

The system maintained stable performance under moderate loads, with response times increasing predictably under heavier user concurrency. Supabase's backend scalability played a crucial role in maintaining database query efficiency.[9], [11]

5.3 Visualization of Crime Data Statistics

Clarity, interactivity, and informativeness characterized the crime data visualization module, with 85% of users reporting both an intuitive and helpful experience with the map. About 90% used and enjoyed the filter and drill-down capabilities for effective exploration of data.

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As an illustration, an analysis of the crime rates of the states disclosed interesting characteristics, such as a predominance of cybercrime in more urbanized states like Maharashtra and Karnataka, as well as considerable variations in crime reporting rates in the different states. Such points endorse the use of interactive visualization tools for making crime data accessible and actionable for users [1], [4], [10].

5.4 Limitations Identified

There were limitations found even after positive outcomes. The chatbot fails to handle complex legal queries outside the realm of FAQs, which hinders its use in subtly differing situations. Accuracy in audio transcription drops when it comes to regional dialects or low-quality recordings; thus reducing reliability.
Summarization skips significant legal points in complex judgments sometimes, which may mislead on those matters. These limitations illustrate the necessity for improving AI adaptability and accuracy. In future work (Section 6), the issues will be dealt with through model fine-tuning, more expansive dataset training, and enhanced processing techniques.

5.5 Summary of Results
The summary of results highlights the effectiveness of Ad- voca across multiple evaluation metrics. Functional accuracy achieved a 94% average pass rate, demonstrating the relia- bility of core features. Usability testing resulted in a score of 4.5 out of 5, reflecting a positive user experience. The document summarization model attained a ROUGE-L score of 0.71, indicating strong content retention. Conclusion Case law retrieval achieved 93% precision, ensuring accurate and relevant search results. The system maintained an average response time between 1.2 to 2.8 seconds, depending on the load. Overall user satisfaction ranged between 85% and 90%, confirming the platform's effectiveness in improving legal research and analysis.

VI. CONCLUSION AND FUTURE WORK

6.1 Conclusion

LegalAI of India is a legal AI-based platform for successful retrieval of information and analysis of data in the Indian legal system. It is powered by artificial intelligence and interactive data visualization to connect between difficult legal data and accessible, user-friendly technology for legal professionals, researchers, students, and the rest of the population.

Major features are AI-driven document summarization, semantic search-based case law retrieval, automated process modeling, as well as interactive crime data visualizations. Audio transcription services, together with that of chatbots, boost the accessibility of the platform and increase user entropy engagement.

The frontend in React and TypeScript guarantees scalability, responsiveness, and secure authentication, for which a Supabase backend was used. Functional, usability, and performance evaluation of the platform speaks volumes of its effectiveness in improving legal research efficiency. Advoca democratizes knowledge access among the populace; hence, it increases legal literacy and access to justice in India.

Here is a good beginning; improvements will focus on training the chatbot on a wider corpus of law, allowing multi- turn conversations, and enabling support for multilingual queries. The audio transcription will, therefore, be made more accurate by introducing robust speech recognition with noise-cancellation.

6.2 Future Work

The legal dataset will also receive several expansions in the form of regulations, statutory interpretations, and tribunal decisions to build a better knowledge base. AI-based analytics will be done to predict judgment outcomes and analyze crime trends. Open-source collaborations with all stakeholders will provide feedback for developing better AI models, whereas constant UI/UX improvements will be through user feedback.

Ongoing maintenance of a legal database integrated with AI decision support will provide law enforcement and policymakers the necessary support for informed decisions.

6.3 Vision for the Future

Advoca, in vision, is to progress as a single-window ecosystem for all legal knowledge. It intends to support legal professionals in conducting quick and accurate research, clear legal information for students and researchers, and ease the understanding of citizens regarding their rights and access to justice. The transformation of the Indian legal paradigm is targeted by innovatively integrating AI, and visualization technologies to propel a more informed and legally empowered society.

REFERENCES

1. S. Sivakumar, et al., "Challenges in Legal Information Retrieval in India: A Comprehensive Review," International Journal of Law and Information Technology, vol. XX, no. X, 2021. [DOI: 10.1093/ijlit/eaaa040].
2. P. Bhattacharya, S. Paul, K. Ghosh, and S. Ghosh, "A Comparative Study of Summarization Techniques for Indian Legal Judgments," in Proc. 17th International Conference on Natural Language Processing (ICON), India, 2019.
3. R. Raghavan, A. Srinivasan, and K. Balaji, "Interactive Crime Data Visualization for Policy Making in India," in Data Science for Policy Makers Workshop, IIIT-Bangalore, 2020.
4. National Crime Records Bureau (NCRB), Crime in India Report 2021. Ministry of Home Affairs, Government of India, 2022. Available: https://ncrb.gov.in/en/crime-india.
5. Indian Kanoon, "Search Engine for Indian Laws and Judgments." [Online]. Available: https://indiankanoon.org/.
6. ROSS Intelligence, "AI-powered Legal Research Tool." [Online]. Available: https://www.rossintelligence.com/.
7. LexisNexis, "AI in Legal Research Solutions." [Online]. Available: https://www.lexisnexis.com/.
8. Supabase, "Open Source Firebase Alternative." [Online]. Available: https://supabase.io/.
9. ReactJS, "A JavaScript Library for Building User Interfaces." [Online]. Available: https://reactjs.org/.
10. TypeScript, "JavaScript with Syntax for Types." [Online]. Available: https://www.typescriptlang.org/.
11. Gemini, "Natural Language Processing and AI Models." [Online]. Available: https://aistudio.google.com/.
12. DataMeet India, "Open Data Community and Visualization Projects." [Online]. Available: https://datameet.org/.

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