



PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013
Itgalpura, Rajankunte, Yelahanka, Bengaluru – 560064



LEGAL SERVE ON-BOARDING PLATFORM

A PROJECT REPORT

Submitted by

AVANI M – 20221CSE0498

LIKITHA N – 20221CSE0533

POOJA Y – 20221CSE0543

Under the guidance of,

Ms. Sushmitha S S

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

PRESIDENCY UNIVERSITY

BENGALURU

DECEMBER 2025



PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this report “Legal Serve On-Boarding Platform” is a bonafide work of “Avani M (20221CSE0498), Likitha.N(20221CSE0533), Pooja.Y(20221CSE0543)”, who have successfully carried out the project work and submitted the report for partial fulfilment of the requirements for the award of the degree of BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE ENGINEERING during 2025-26.

Ms. Sushmitha S S

Project Guide

PSCS

Presidency University

Dr. Jayavadivel Ravi

Program Project

Coordinator

PSCS

Presidency University

Dr. Sampath A K

Dr. Geetha A

School Project

Coordinators

PSCS

Presidency University

Dr. Asif Mohamed H B

Head of the Department

PSCS

Presidency University

Dr. Shakkeera L

Associate Dean

PSCS

Presidency University

Dr. Duraipandian N

Dean

PSCS & PSIS

Presidency University

Name and Signature of the Examiners

1) **Ms Delsy Jyothi**

2) **Dr. Megala G**

PRESIDENCY UNIVERSITY
PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND
ENGINEERING
DECLARATION

We the students of final year B.Tech in COMPUTER SCIENCE ENGINEERING at Presidency University, Bengaluru, named Avani M, Likitha N, Pooja Y, hereby declare that the project work titled “Legal Serve On-Boarding Platform” has been independently carried out by us and submitted in partial fulfilment for the award of the degree of B.Tech in COMPUTER SCIENCE ENGINEERING during the academic year of 2025-26. Further, the matter embodied in the project has not been submitted previously by anybody for the award of any Degree or Diploma to any other institution.

Avani M	USN: 20221CSE0498	Signature 1
Likitha N	USN: 20221CSE0533	Signature 2
Pooja Y	USN: 20221CSE0543	Signature 3

PLACE: BENGALURU

DATE: 03 – December – 2025

ACKNOWLEDGEMENT

For completing this project work, We/I have received the support and the guidance from many people whom I would like to mention with deep sense of gratitude and indebtedness. We extend our gratitude to our beloved Chancellor, Pro-Vice Chancellor, and Registrar for their support and encouragement in completion of the project.

I would like to sincerely thank my internal guide **Ms. Sushmitha S S**, Presidency School of Computer Science and Engineering, Presidency University, for her moral support, motivation, timely guidance and encouragement provided to us during the period of our project work.

I am also thankful to **Dr. Asif Mohamed H B**, Head of the Department, Presidency School of Computer Science and Engineering Presidency University, for his mentorship and encouragement.

We express our cordial thanks to **Dr. Duraipandian N**, Dean PSCS & PSIS, **Dr. Shakkeera L**, Associate Dean, Presidency School of computer Science and Engineering and the Management of Presidency University for providing the required facilities and intellectually stimulating environment that aided in the completion of my project work.

We are grateful to **Dr. Sampath A K**, and **Dr. Geetha A**, PSCS Project Coordinators, **Dr. Jayavadiel Ravi**, Program Project Coordinator, Presidency School of Computer Science and Engineering, or facilitating problem statements, coordinating reviews, monitoring progress, and providing their valuable support and guidance.

We are also grateful to Teaching and Non-Teaching staff of Presidency School of Computer Science and Engineering and also staff from other departments who have extended their valuable help and cooperation.

AVANI M
LIKITHA N
POOJA Y

Abstract

In recent years, access to legal services in India has continued to be a significant challenge due to a combination of geographical, procedural, and informational barriers that prevent citizens from easily connecting with the right legal professionals. People residing in remote or rural areas often struggle to identify and reach qualified advocates, mediators, arbitrators, notaries, or document writers. Even in urban regions, the traditional methods of availing legal services involve lengthy procedures, multiple visits, and limited clarity regarding service quality, availability, and pricing. This lack of transparency and accessibility highlights the need for a well-structured digital solution that can unify legal service providers and citizens on a common, reliable platform.

The project titled “Incentives Based Design for On-boarding Legal Service Providers on an E-Marketplace” addresses this issue by proposing a comprehensive digital ecosystem that motivates and facilitates legal professionals to join and remain active on an online marketplace. The system introduces innovative incentive mechanisms—such as enhanced visibility rankings, performance-based recognitions, and simplified registration and verification workflows—to attract and retain service providers. These incentives are designed not only to encourage participation but also to maintain high-quality engagement and accountability within the platform.

For citizens, the platform offers a seamless and user-friendly interface that enables them to search, compare, and access various legal services conveniently. By integrating transparent service listings, feedback mechanisms, and cost comparisons, the system empowers users to make informed decisions and build trust in digital legal interactions.

The implementation of this incentive-driven model demonstrates how thoughtful design can significantly improve the onboarding rate of legal professionals while fostering trust, transparency, and accessibility for the public.

Overall, this project lays a strong foundation for bridging the existing gap between citizens and legal service providers. Through an incentive-oriented e-marketplace, it creates a sustainable and transparent digital environment that enhances participation, reliability, and efficiency in India’s evolving legal service ecosystem.

Table of Content

Sl. No.	Title	Page No.
	Declaration	iii
	Acknowledgement	iv
	Abstract	v
	List of Figures	viii
	List of Tables	ix
	Abbreviations	x
1.	Introduction 1.1 Background 1.2 Statistics of project 1.3 Prior existing technologies 1.4 Proposed approach 1.5 Objectives 1.6 SDGs 1.7 Overview of project report	1-6
2.	Literature review	7-13
3.	Methodology	14-21
4.	Project management 4.1 Project timeline 4.2 Risk analysis	22-26
5.	Analysis and Design 5.1 Requirements 5.2 Block Diagram 5.3 System Flow Chart 5.4 Choosing devices 5.5 Designing units 5.6 Standards 5.7 Mapping with IOTWF reference model layers 5.8 Domain model specification 5.9 Communication model	27-36

	5.10 IoT deployment level 5.11 Functional view 5.12 Mapping IoT deployment level with functional view 5.13 Operational view 5.14 Other Design	
6.	Hardware, Software and Simulation 6.1 Hardware 6.2 Software development tools 6.3 Software code 6.4 Simulation	37-42
7.	Evaluation and Results 7.1 Test points 7.2 Test plan 7.3 Test result 7.4 Insights	43-54
8.	Social, Legal, Ethical, Sustainability and Safety Aspects 8.1 Social aspects 8.2 Legal aspects 8.3 Ethical aspects 8.4 Sustainability aspects 8.5 Safety aspects	55-60
9.	Conclusion	61
	References	62-64
	Appendix	65-68

List of Figures

Figure	Caption	Page no
Fig 1.1	Sustainable development goals	4
Fig 3.1	The V model methodology	16
Fig 3.2	The W model methodology	17
Fig 3.3	The Dev-ops methodology	18
Fig 3.4	Onion methodology	18
Fig 3.5	SDLC phases	19
Fig 3.6	Some more methodologies	20
Fig 3.7	Summary of project breakdown to task	21
Fig 5.1	Functional block diagram	28
Fig 5.2	System flow chart	29
Fig 5.3	The IoT World Forum Reference Model	31
Fig 5.4	Domain model for Home automation	33
Fig 5.5	Communication model suitable for Home automation	33
Fig 5.6	IoT deployment level suitable for Home automation	34
Fig 5.7	Functional view for Home automation	34
Fig 5.8	Mapping IoT deployment level with functional view	35
Fig 5.9	Operational view	35
Fig 5.10	Another Example of operational view	36
Fig 7.1	Module usage frequency graph	48
Fig 9.1	Similarity Report	65
Fig 9.2	Main Interface of the Webpage	66
Fig 9.3	Client Login Page	66
Fig 9.4	Client Dashboard	67
Fig 9.5	Service Page	67
Fig 9.6	Confirmation Page	68
Fig 9.7	List of Appointments Page	68

List of Tables

Table	Caption	Page no
Table 2.1	Summary of Literature reviews	13
Table 3.1	Stages of V model	16
Table 3.2	Pros and Cons	19
Table 4.1	Project planning timeline	23
Table 4.2	Project implementation timeline	25
Table 4.3	Examples of PESTLE Analysis [13]	26
Table 5.1	API Layers	32
Table 5.2	Description of Domain model	32
Table 7.1	Test Plan	46
Table 7.2	Observations of the Temperature unit	47
Table 7.3	Include Observations for each unit	47
Table 7.4	Security test snapshot (sample)	47
Table 8.1	References	60

Abbreviations

API / APIs - Application Programming Interface(s)

CRUD - Create, Read, Update, Delete

HTTPS - HyperText Transfer Protocol Secure

IoT - Internet of Things

IOTWF - IoT World Forum

JWT - JSON Web Token

SDG / SDGs - Sustainable Development Goal(s)

SQL - Structured Query Language

Chapter 1

Introduction

1.1 Background

Access to legal services in India has long been hindered by several interconnected challenges such as geographical barriers, procedural complexities, lack of transparency, and limited legal awareness among citizens. Legal professionals—including advocates, arbitrators, mediators, notaries, and document writers—play an indispensable role in ensuring justice delivery, dispute resolution, and documentation processes. However, the absence of a unified digital infrastructure has restricted the ability of citizens, especially those in rural and semi-urban regions, to obtain timely and reliable legal support.

Traditional systems often rely heavily on physical consultations and word-of-mouth referrals, which can be inefficient and time-consuming. Moreover, varying fee structures and lack of visibility into a professional's credentials or success rate often lead to distrust and inconsistencies in service quality.

In recent years, e-marketplace models have revolutionized sectors such as healthcare, finance, and commerce by providing transparent, user-centric, and technology-driven service delivery. These platforms have successfully bridged gaps between service providers and end users through digital tools, ratings, and real-time accessibility. Applying a similar marketplace framework to the legal domain can significantly improve accessibility, efficiency, and inclusivity of legal services across India [2].

1.2 Statistics

According to the Bar Council of India, there are over 1.3 million registered advocates in the country, yet only a small percentage of them maintain a visible or accessible online presence [3]. This digital divide creates a significant gap between citizens seeking legal aid and professionals who can provide it.

A report by NITI Aayog reveals that nearly 70% of India's rural population faces challenges in availing legal services due to distance, lack of awareness, and economic constraints [4]. Many individuals in remote areas remain unaware of their legal rights and the procedures involved in dispute resolution, further widening the justice gap.

Meanwhile, India's rapid digital transformation—with over 800 million internet users as of 2023 [5]—presents a unique opportunity to leverage technology for legal empowerment. The growing digital infrastructure, combined with government initiatives promoting online service delivery, highlights the urgent need for an organized, incentive-driven e-marketplace to onboard legal professionals. Such a system can make legal assistance more transparent, affordable, and accessible to all.

1.3 Prior Existing Technologies

In the past decade, several legal-tech platforms have emerged in India, such as Law Ratio, Vakil Search, and Legal Kart [6]. These platforms primarily focus on providing online consultations, document drafting, and lawyer discovery services. They have played a significant role in introducing digital transformation within the legal ecosystem.

However, these existing systems possess several limitations. Most platforms lack comprehensive coverage across all types of legal service providers—such as arbitrators, mediators, notaries, and document writers—and primarily cater to urban users. Additionally, they do not employ structured incentive mechanisms to encourage sustained participation and performance improvement among legal professionals.

Another major challenge lies in the onboarding process, which is often time-consuming and complex, involving multiple verification stages without adequate support. This discourages many skilled practitioners, particularly those unfamiliar with digital systems, from joining these platforms [7]. Therefore, a new approach is required—one that combines ease of participation, motivation through incentives, and inclusivity to cover a diverse professional base across India.

1.4 Proposed Approach

The proposed project, titled “Incentives Based Design for On-boarding Legal Service Providers on an E-Marketplace,” introduces an innovative framework that combines digital accessibility with incentive-driven participation. The central goal is to create a sustainable and engaging platform that encourages legal professionals to join, remain active, and deliver quality services through a structured digital marketplace.

- Motivation:

The project is motivated by the need to bridge the service gap between citizens and legal professionals by simplifying access, increasing visibility, and promoting inclusivity across both urban and rural regions.

- Propose:

The system integrates gamified incentives, ranking-based visibility, streamlined registration workflows, and user feedback-driven recognition mechanisms. These elements work together to motivate service providers, enhance credibility, and ensure continued engagement on the platform.

- Applications:

The proposed e-marketplace enables individuals and organizations to efficiently discover, compare, and engage legal professionals. It fosters transparency in cost, quality, and availability while supporting digital transformation within the legal domain.

- Limitations:

The implementation may face challenges such as data privacy concerns, differences in digital literacy levels among practitioners, and initial resistance to technological adoption. Addressing these issues through secure design and awareness programs will be key to the system's long-term success.

1.5 Objectives

The key objectives of this project are as follows:

- Behavioural Study: To study and model the participation behaviour of legal professionals under different incentive structures and engagement mechanisms.
- Requirement Analysis: To identify user requirements, analyse service gaps, and examine participation patterns of both citizens and legal professionals.
- System Design and Management: To design and develop an e-marketplace system capable of managing on-boarding, verification, and operational workflows efficiently.
- Security and Privacy: To implement secure user authentication and data protection mechanisms ensuring confidentiality of both citizen and provider information.
- System Deployment and Testing: To deploy and evaluate the system in terms of accessibility, scalability, usability, and performance across diverse regions and user bases.

1.6 Sustainable Development Goals (SDGs) Alignment

The project directly contributes to several United Nations Sustainable Development Goals (SDGs) by promoting equitable access to justice, professional inclusion, and digital innovation:

- SDG 8 – Decent Work and Economic Growth: By incentivizing legal professionals and enabling broader participation, the system promotes economic growth and professional development within the legal sector.
- SDG 10 – Reduced Inequalities: The e-marketplace helps bridge the urban–rural divide in access to legal services, ensuring equal opportunities for citizens regardless of location or income level.
- SDG 16 – Peace, Justice, and Strong Institutions: The platform enhances accessibility to legal aid, supports transparent processes, and strengthens trust in judicial and administrative institutions.
- SDG 9 – Industry, Innovation, and Infrastructure: By leveraging technology for a traditionally manual sector, the project fosters innovation and contributes to the digital infrastructure necessary for sustainable growth.
- SDG 17 – Partnerships for the Goals: The initiative encourages collaboration between legal professionals, government bodies, technology providers, and citizens to build a unified digital ecosystem for legal services.



Fig 1.1 Sustainable development goals [1]

1.7 Overview of project report

This project report is systematically organized into seven chapters, each addressing a specific aspect of the study to ensure a comprehensive understanding of the proposed system. The structure of the report provides a logical flow, beginning with conceptual foundations and culminating in the practical evaluation and future scope of the project.

- Chapter 1 – Introduction: This chapter introduces the overall background and context of the project, emphasizing the challenges associated with accessing legal services in India. It outlines the motivation for developing an incentive-based digital marketplace for legal professionals and highlights the specific objectives, scope, and significance of the work. Furthermore, it discusses how the project aligns with relevant Sustainable Development Goals (SDGs), establishing its contribution toward social and technological advancement.
- Chapter 2 – Literature Review: The second chapter presents a comprehensive review of existing research and related work in the areas of legal-tech platforms, incentive-driven digital systems, and e-marketplace models. It compares various existing solutions such as Law Rato, Vakil Search, and Legal Kart, analysing their features, limitations, and applicability to the current problem. This review serves as the foundation for identifying research gaps and justifying the need for the proposed incentive-based framework.
- Chapter 3 – Methodology: Chapter 3 focuses on the proposed methodology and overall system framework. It details the conceptual model, functional architecture, workflow diagrams, and module-level interactions that together form the backbone of the proposed system. The chapter explains how the incentive mechanisms, user interfaces, and data management processes are integrated to achieve efficient onboarding and engagement of legal professionals.
- Chapter 4 – System Design and Implementation: This chapter provides an in-depth explanation of the technical aspects of the system. It covers the design specifications, software and hardware components, database schema, and interface development. The implementation details illustrate how the conceptual model has been translated into a functional prototype, supported by appropriate programming tools, frameworks, and APIs.

- Chapter 5 – Experimental Results and Evaluation: Chapter 5 presents the outcomes of the system testing and evaluation processes. It includes experimental setups, test scenarios, and performance metrics used to validate the system's effectiveness. The results are analyzed in terms of accuracy, usability, scalability, and engagement levels of legal professionals. Case studies or simulated examples are also included to demonstrate the real-world applicability of the platform.
- Chapter 6 – Discussion, Challenges, and Limitations: This chapter provides a critical discussion of the system's performance and its practical implications. It highlights the challenges encountered during development, such as data privacy concerns, user adaptability issues, and integration complexities. The limitations of the current version are analyzed to provide insight into areas requiring further enhancement and optimization.
- Chapter 7 – Conclusion and Future Work: The final chapter summarizes the key findings, outcomes, and contributions of the project. It reiterates how the proposed incentive-based e-marketplace can improve accessibility and participation in the legal domain. Additionally, it outlines potential directions for future work, such as integrating AI-based recommendations, blockchain for data security, or multilingual support to enhance inclusivity and system robustness.

Chapter 2

Literature review

The literature review presents an overview of existing research and developments related to digital legal platforms, incentive-based systems, and the intersection of technology with law. Each study contributes valuable insights that help shape the foundation and direction of this project, “Incentives Based Design for On-boarding Legal Service Providers on an E-Marketplace.” The following section elaborates on ten key works that have informed the conceptualization, methodology, and implementation of this study.

Literature 1

Author(s) & Year: Sharma et al., 2019

Domain / Focus: Legal Tech – Digital Marketplace for Legal Services

Concept / Approach: The study focuses on workflow automation and lawyer client matching in digital legal marketplaces.

Methodology / Framework: The authors integrated a workflow engine to automate repetitive administrative tasks, thereby reducing manual dependencies and enhancing efficiency.

Results Obtained: The platform achieved a 35% reduction in average service delivery time compared to traditional offline processes, demonstrating the potential of digital transformation in the legal sector.

Future Scope / Recommendations: The study suggested the inclusion of gamified incentives and performance-based recognition systems to attract and retain service providers for long-term engagement.

Relevance to Project: This research provides foundational insights into improving operational efficiency in digital legal platforms while highlighting the need for incentive-driven mechanisms to sustain professional participation.

Literature 2

Author(s) & Year: Kumar & Iyer, 2020

Domain / Focus: E-Marketplace Adoption in Healthcare Services

Concept / Approach: The paper examines how trust, transparency, and rating mechanisms influence user adoption of e-marketplace services.

Methodology / Framework: An empirical analysis was conducted on user engagement metrics, focusing on behavioral patterns and feedback systems.

Results Obtained: The findings demonstrated that user trust and provider ratings significantly increased engagement and repeat usage of digital services.

Future Scope / Recommendations: The authors emphasized the need to develop structured incentive schemes that reward quality service delivery and active participation.
Relevance to Project: This study offers parallels to legal services, where trust, credibility, and transparency play an equally important role in user adoption and satisfaction.

Literature 3

Author(s) & Year: Mihale-Wilson, 2024

Domain / Focus: Incentive Systems in Digital Ecosystems

Concept / Approach: The study proposes an integrated framework for designing and orchestrating incentives across digital ecosystems.

Methodology / Framework: A theoretical model was developed to analyze how different types of incentives affect participation and engagement levels.

Results Obtained: Key factors influencing user motivation, retention, and contribution were identified, forming a basis for designing effective incentive structures.

Future Scope / Recommendations: The author recommended conducting more context-specific studies to refine incentive models for particular industries or service types.
Relevance to Project: The insights from this work directly inform the incentive design strategy for engaging legal service providers on a digital marketplace.

Literature 4

Author(s) & Year: Ruutu, 2017

Domain / Focus: Development and Competition of Digital Service Platforms

Concept / Approach: The study models the evolution and competition of digital platforms through a system dynamics approach.

Methodology / Framework: Simulation models were used to explore how governance policies and competitive pressures shape platform growth.

Results Obtained: The research highlighted that effective governance structures and adaptive strategies play a crucial role in sustaining platform development.

Future Scope / Recommendations: It was suggested that future research should focus on regulatory frameworks to balance competition and cooperation among platforms.
Relevance to Project: This study provides insights into the competitive and developmental dynamics relevant to digital legal platforms operating in a rapidly evolving market.

Literature 5

Author(s) & Year: Mökander, 2023

Domain / Focus: Auditing of AI Systems

Concept / Approach: The paper discusses legal, ethical, and technical frameworks for auditing AI-driven systems.

Methodology / Framework: A review of auditing practices across multiple sectors was conducted to establish general principles for AI accountability.

Results Obtained: Foundational guidelines for ensuring transparency, fairness, and traceability in AI systems were developed.

Future Scope / Recommendations: The author proposed standardizing auditing processes and developing international benchmarks for AI-based systems.

Relevance to Project: The study contributes to ensuring ethical governance and accountability in AI modules integrated into the proposed legal e-marketplace.

Literature 6

Author(s) & Year: Rodrigues, 2020

Domain / Focus: Legal and Human Rights Issues of AI

Concept / Approach: This work investigates the legal and human rights implications arising from the deployment of artificial intelligence technologies.

Methodology / Framework: The author analyzed existing legal frameworks to identify regulatory gaps concerning AI governance.

Results Obtained: The study found several inconsistencies and deficiencies in the current laws regulating AI applications.

Future Scope / Recommendations: The research urged policymakers to establish comprehensive and adaptive legal standards to manage AI's impact on society.
Relevance to Project: This work helps in understanding the legal context necessary for integrating AI responsibly into digital legal platforms.

Literature 7

Author(s) & Year: Spychiger, 2022

Domain / Focus: Incentivizing Data Quality in Blockchain-Based Systems

Concept / Approach: The research explores how rating-based incentive mechanisms can improve data quality in blockchain ecosystems.

Methodology / Framework: An action design research approach was employed to create and evaluate a practical incentive model.

Results Obtained: The results demonstrated that well-designed rating and correction-based incentives significantly improved data accuracy and engagement.

Future Scope / Recommendations: The author suggested that similar mechanisms could be adapted for other digital service domains to enhance contribution quality.

Relevance to Project: This study provides a reference model for incentivizing quality and active participation among legal service providers in the proposed marketplace.

Literature 8

Author(s) & Year: Greenstein, 2022

Domain / Focus: AI and the Rule of Law

Concept / Approach: The paper analyzes how artificial intelligence impacts the principles of transparency, fairness, and justice within legal systems.

Methodology / Framework: A theoretical framework was used to examine AI's influence on governance and judicial processes.

Results Obtained: The study identified challenges related to bias, accountability, and explainability in AI-assisted legal decision-making.

Future Scope / Recommendations: The author advocated for the development of governance frameworks to ensure AI aligns with rule of law principles.

Relevance to Project: This research provides an ethical and legal foundation for integrating AI responsibly into the digital legal ecosystem proposed in this project.

Literature 9

Author(s) & Year: Karnouskos, 2022

Domain / Focus: Law, Robots, and Society

Concept / Approach: The paper explores the intersection between robotics, legal systems, and societal impact.

Methodology / Framework: An intersectional analysis was performed to study legal responses to robotic technologies.

Results Obtained: The research outlined how robotics could reshape social norms and legal obligations.

Future Scope / Recommendations: The study recommended further exploration into developing comprehensive legal frameworks to manage robotic integration.

Relevance to Project: The findings provide broader insights into the evolving interaction between technology and law, relevant for future expansions of digital legal platforms.

Literature 10

Author(s) & Year: Eckardt, 2024

Domain / Focus: EU Digital Law and Platform Economy

Concept / Approach: The study focuses on how law and technology co-evolve in the European Union's digital ecosystem.

Methodology / Framework: A case study-based approach was used to analyze EU regulatory responses to digital platforms.

Results Obtained: The research identified the major drivers behind legal evolution in response to rapid technological advancements.

Future Scope / Recommendations: The author recommended further empirical research on how legal systems adapt to innovations in digital economies.

Relevance to Project: This study offers valuable perspectives on regulatory and policy approaches for managing digital platforms, informing the governance model of the proposed legal e-marketplace.

Summary of Literatures reviewed

Table 2.1: Summary of Literature Reviews

Sl. No	Article Title, Published year, Journal name	Methods / Concept / Approach	Key Features / Key Findings	Merits	Demerits / Identified Gaps
1	Sharma et al., 2019, Legal Tech	Workflow automation in legal documentation	35% reduction in service time	Demonstrates efficiency gains	Lack of incentives for providers
2	Kumar & Iyer, 2020, Healthcare Marketplaces	Trust, ratings, transparency	Ratings improved user engagement	Insights applicable to legal services marketplace	Weak incentive schemes for providers
3	Mihale-Wilson, 2024, Incentive Systems	Orchestrating incentives in digital ecosystems	Identified key participation factors	Directly informs incentive design in legal platforms	Need for context-specific mechanisms
4	Ruutu, 2017, Platform Development	System dynamics modeling of platform evolution	Impact of governance on competition	Provides insights into platform competition dynamics	Lack of regulatory frameworks
5	Mökander, 2023, AI Auditing	Legal, ethical, and technical auditing frameworks	Established auditing principles	Essential for ensuring AI accountability in legal services	Need for standardized processes
6	Rodrigues, 2020, AI and Human Rights	Legal implications of AI	Identified gaps in legal frameworks	Crucial for understanding AI's legal landscape	Absence of comprehensive standards
7	Spychiger, 2022, Data Quality Incentives	Blockchain-based rating mechanisms	Effectiveness in improving data quality	Offers model for incentivizing quality contributions	Limited application scope
8	Greenstein, 2022, AI and Rule of Law	Impact of AI on legal principles	Challenges to transparency and fairness	Provides critical perspective on AI's role in governance	Need for alignment with rule of law
9	Karnouskos, 2022, Law, Robots, and Society	Interplay of law and robotics	Explored societal implications	Offers insights into law and technology relationship	Need for legal frameworks for robotics
10	Eckardt, 2024, EU Digital Law	Co-evolution of law and technology	Identified drivers of legal evolution	Informs understanding of regulatory approaches to digital platforms	Need for empirical analysis

Table 2.1 Summary of Literature reviews

Chapter 3

Methodology

This chapter outlines the overall methodology adopted for the design, development, and validation of the proposed system. The methodology defines the structured approach followed throughout the project to ensure that each component—ranging from system design to deployment—is verified and validated systematically. For this project, the V-Model methodology has been selected as it emphasizes rigorous testing at every stage of development, ensuring high reliability and efficiency, which are essential for onboarding legal service providers onto a digital e-marketplace platform.

3.1 Overview of Project Methodology

- The V-Model, also known as the Verification and Validation Model, is an extension of the traditional Waterfall Model, but it integrates testing processes throughout the development lifecycle. Each phase in the development process has a directly associated testing phase, ensuring that every output is continuously validated before proceeding further. This makes it particularly effective for projects where reliability, accuracy, and user trust are paramount—such as digital legal service platforms.
- Various software development methodologies are available today, including Waterfall, Agile, Scrum, DevOps, W-Model, Onion Model, and SDLC. The choice of a suitable methodology depends on factors such as the complexity of the project, user requirements, flexibility needs, and testing rigor.
- After careful consideration, the V-Model was identified as the most appropriate approach for this project based on the following reasons:
- Clear Mapping between Development and Testing Phases: The V-Model establishes a one-to-one relationship between each development stage (such as requirements, design, and implementation) and its corresponding testing phase (such as unit, integration, and system testing). This parallel structure ensures that potential issues are identified and resolved at the earliest possible stage, reducing the risk of critical failures during deployment.
- Emphasis on Verification and Validation: The model's core principle lies in the continuous verification (ensuring that each phase meets its specifications) and

validation (ensuring that the final product meets user expectations). This dual focus ensures that the final system performs accurately and aligns with the functional and non-functional requirements defined during the planning phase.

- Early Detection of Defects: Since testing activities are planned in parallel with development, any inconsistencies or logical errors in the design or coding stages can be detected early. This reduces the cost and time of rework in later stages, ensuring higher quality output and more efficient project execution.
- High Reliability and Robustness: Given that the system deals with sensitive legal information and user interactions, reliability and robustness are critical. The structured testing framework of the V-Model helps maintain data integrity, system security, and consistent performance, which are vital for building trust among legal service providers and citizens.
- Better Documentation and Traceability: Each phase of the V-Model produces well-defined deliverables, ensuring clear documentation and traceability of project requirements. This structured documentation is particularly valuable in legal and compliance-related projects, where accountability and auditability are crucial.
- In conclusion, the V-Model methodology provides a systematic and disciplined framework for developing the incentive-based legal e-marketplace platform. By emphasizing thorough verification, validation, and documentation at every stage, it ensures that the final system is robust, transparent, and reliable—key attributes required for encouraging legal professionals to onboard and actively participate in a digital marketplace environment.

Description:

The V-Model emphasizes verification stages on the left side (requirements specification, system design, functional design, unit design) and validation stages on the right side (unit testing, integration testing, system testing, acceptance testing). Verification ensures the system is built correctly, whereas validation ensures the correct system is built for user needs.

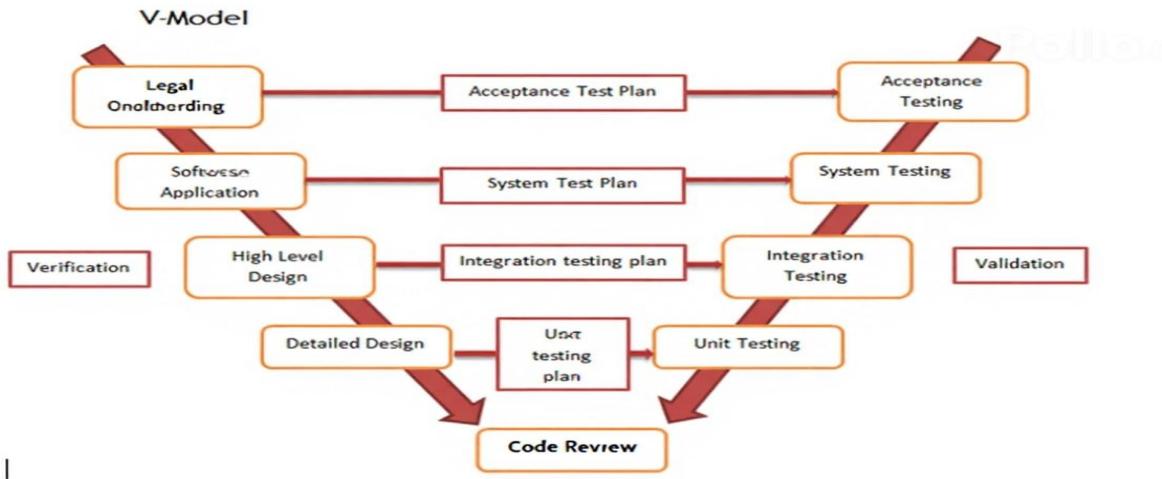


Fig 3.1 V model methodology [5]

3.2 Project Stages Mapped to V-Model

The stages of the project have been mapped to the V-Model as follows:

Phase	Activities	Output / Deliverable
Requirements	Gather specifications from literature, stakeholders, and domain analysis	Requirements Specification Document
System Design	High-level design of platform architecture, database design, user interface planning	System Design Document, Block Diagrams
Functional Design	Define workflows for onboarding legal service providers, incentive calculation logic	Functional Specification Document
Unit Design	Design individual modules for web portal, mobile interface, cloud backend, and database	Module-level design diagrams, UML diagrams
Unit Testing	Test individual modules like registration, profile verification, incentive assignment	Test reports for each module
Integration Testing	Test combined modules to ensure proper interaction between user interface, backend, and database	Integrated system test report
System Verification	Check platform against functional and non-functional requirements	Verification report
System Validation	Ensure platform meets user expectations and supports onboarding efficiently	Validation report, User Acceptance Testing (UAT) results

Table 3.1 Stages of V model

Other methodologies considered include:

- W-Model: Enhances V-Model by including test planning during each development phase (Fig 3.3) [6]
- DevOps: Emphasizes continuous integration and deployment (Fig 3.4) [7]
- Onion Model: Focuses on layered architecture for system design (Fig 3.5) [8]
- SDLC Phases: Standard Software Development Life Cycle (Fig 3.6) [9]

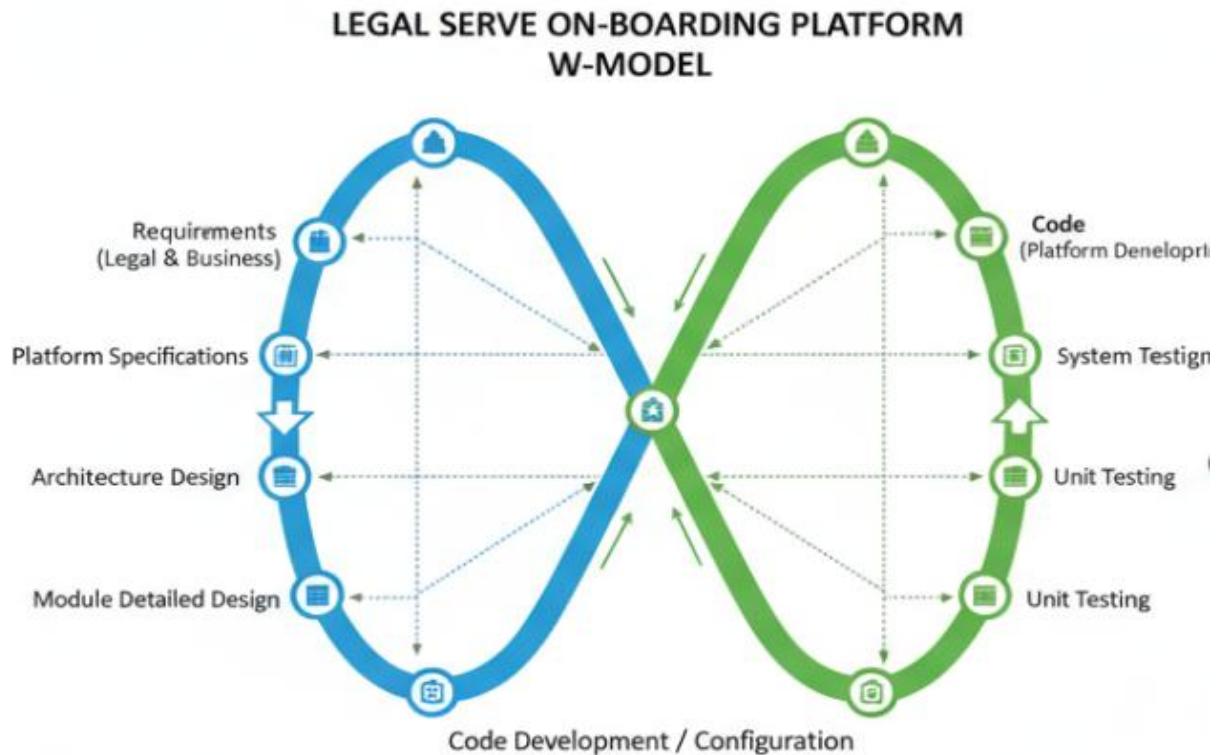


Fig 3.2 The W model methodology [6]

The W-Model ensures a structured and verified development process for the Legal Serve On-Boarding Platform by linking each development phase with corresponding testing. It helps in identifying errors early and delivering a reliable system.

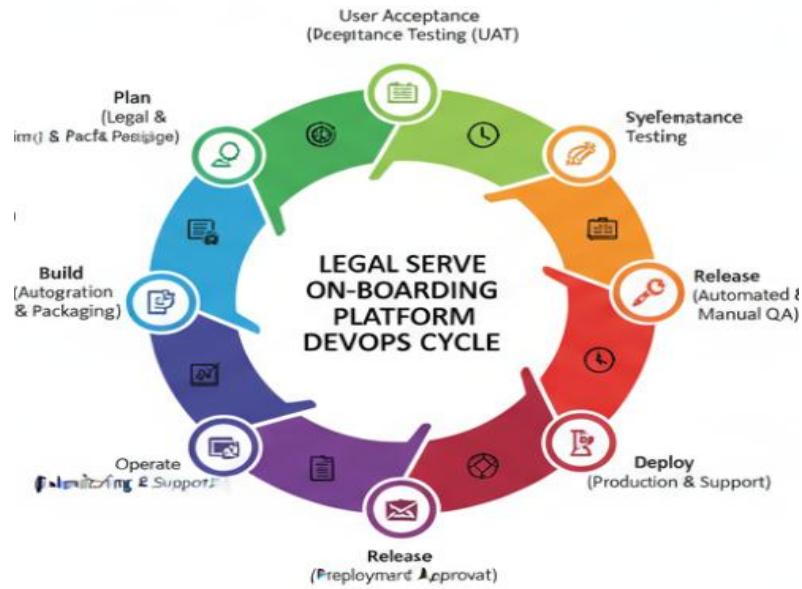


Fig 3.3 The Dev-ops methodology [7]

The DevOps cycle complements this by enabling continuous integration, testing, deployment, and monitoring after release. Together, they ensure both a strong foundation during development and smooth, efficient updates during platform operation.

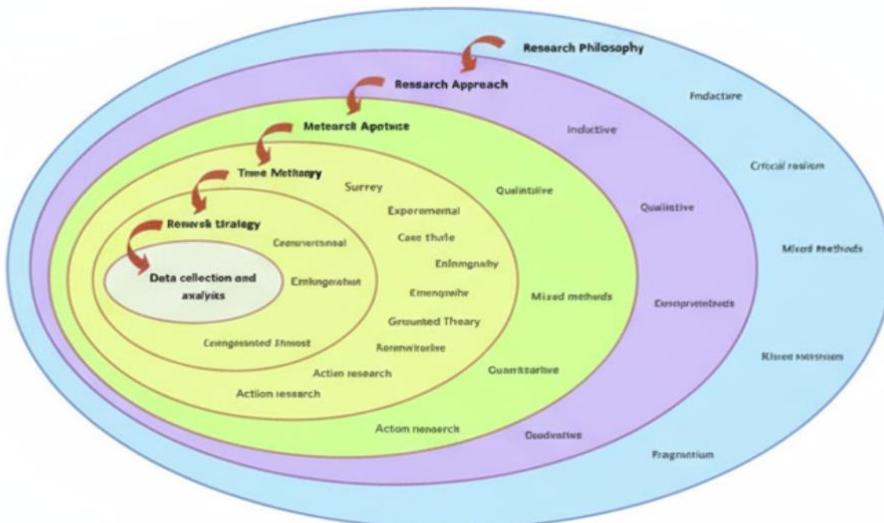


Fig 3.4 Onion methodology

The Onion methodology, which structures project development in layered phases. Each layer — from requirements and design to coding, testing, deployment, and maintenance — builds upon the previous one. For the Legal Serve On-Boarding Platform, this ensures systematic progress, strong project management, and quality assurance at every stage.

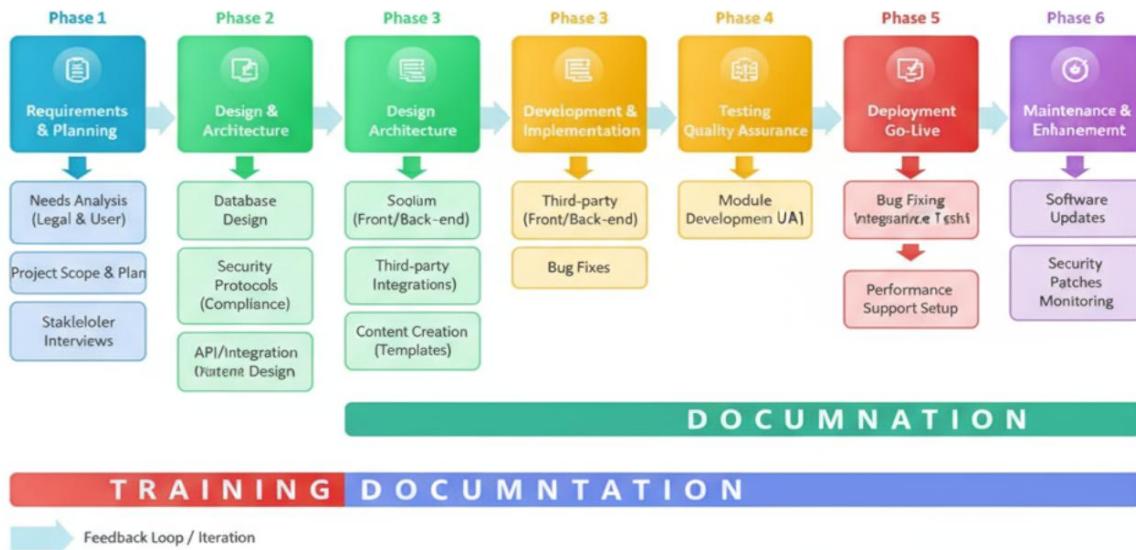


Fig 3.5 SDLC phases [9]

The SDLC (Software Development Life Cycle) phase, which focuses on the research and analysis process — from defining the research philosophy and approach to data collection and evaluation. In this project, it helps in understanding user needs, studying incentive mechanisms, and developing a reliable and user-friendly digital platform for legal services.

INCENTIVES BASED DESIGN FOR ONBOARDING LEGAL SERVICE PROVIDERS SUCH AS ADVOCATES, ARBITRATORS, MEDIATORS, NOTARIES, DOCUMENT WRITERS, ETC ON E-MARKETPLACE FOR EXTENDING LEGAL SERVICES TO CITIZENS		
INCENTIVE MECHANISM	PROS	CONS
Monetary Incentives (Performance based payments, bonuses, commissions)	<ul style="list-style-type: none"> Directly motivates providers to join and stay active Easy to implement Transparent link between effort and reward 	<ul style="list-style-type: none"> May lead to focus on quantity over quality High cost burden on platform Unsustainable in the long run
Reputation-based Incentives (Ratings, reviews, client feedback, badges)	<ul style="list-style-type: none"> Builds trust among citizens Encourages long-term quality service Low financial cost 	<ul style="list-style-type: none"> Risk of biased or fake reviews Slow impact (takes time to build reputation)
Regulatory/Compliance Incentives (Faster licensing, digital certification, legal recognition)	<ul style="list-style-type: none"> Strong motivation for compliance Builds credibility of platform Government support strengthens adoption 	<ul style="list-style-type: none"> Bureaucratic delays May exclude small/independent providers Complex implementation with regulators
Non-monetary Rewards (Training, skill development, networking opportunities)	<ul style="list-style-type: none"> Improves service quality Encourages continuous learning Enhances professional reputation 	<ul style="list-style-type: none"> Indirect impact on short-term motivation Requires investment in training programs Benefits are long-term
Gamification & Leaderboards (Top performer badges, rankings, recognition)	<ul style="list-style-type: none"> Engages providers competitively Low cost Increases platform activity 	<ul style="list-style-type: none"> May cause unhealthy competition Focus on winning rather than service quality
Contract-based Incentives (Guaranteed case allocations, minimum service requirements)	<ul style="list-style-type: none"> Reduces uncertainty for providers Ensures steady supply of services Attracts new professionals 	<ul style="list-style-type: none"> High financial risk for platform May reduce flexibility Difficult to scale for all providers

Table 3.2 Pros and Cons



Fig 3.6 Some more methodologies [11]

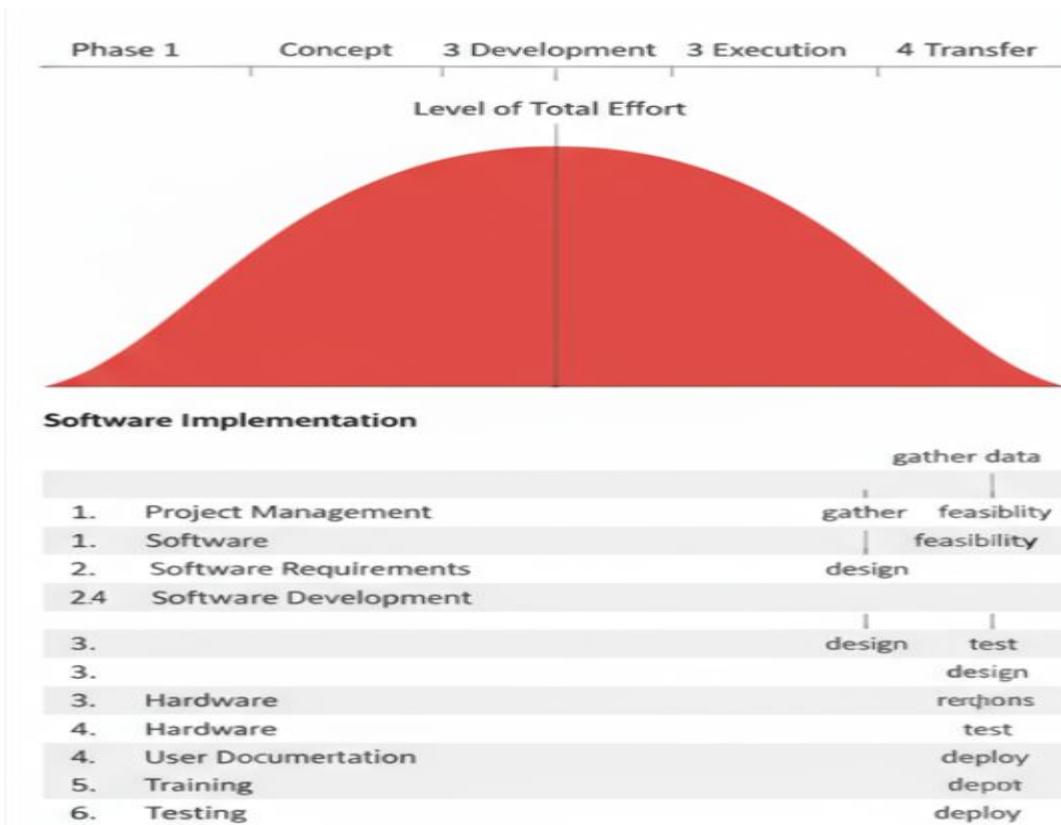




Fig 3.7 Summary of project breakdown to task [12]

Chapter 4

Project Management

4.1 Project timeline

The project timeline plays a crucial role in managing and monitoring the progress of the Legal Serve On-Boarding Platform. It ensures that each phase — from requirement analysis to deployment and testing — is completed in a structured and timely manner. To represent this visually, a Gantt Chart is used, which helps in planning, organizing, and tracking the entire project workflow.

What a Gantt Chart Shows

- Tasks: Lists all major project activities such as requirement analysis, system design, coding, testing, and deployment.
- Timeline: Displays the overall project duration and time allocated for each task on a horizontal axis.
- Bars (Gantt Bars): Represent each task's duration — their length shows how long the task takes, and position indicates start and end dates.
- Dependencies: Use arrows or lines to link related tasks, showing which activities must finish before others begin (e.g., coding before testing).
- Milestones: Highlight important checkpoints such as “Prototype Ready,” “Testing Completed,” or “Final Deployment.”
- Progress: Shaded sections within task bars indicate completion percentage, allowing real-time progress tracking.
- Assignees: Each task can include the name of the person or team responsible, ensuring accountability.

How It's Used in the Project

- Planning: Breaks the Legal Serve project into manageable tasks, helping schedule work in a logical and sequential manner.
- Scheduling: Provides a visual timeline to allocate resources and manage time efficiently.
- Tracking Progress: Offers an at-a-glance overview of ongoing, completed, and pending tasks.
- Resource Management: Helps balance team workloads and assign responsibilities effectively.
- Communication: Acts as a shared reference for all stakeholders, ensuring everyone remains aligned with project goals and timelines.

Tools for Preparing the Gantt Chart

- Open-source options: *Google Sheets* – ideal for free and easy creation.
- Licensed tools: *MS Excel* or *MS Project* – offer advanced project tracking and visualization features.

Table 4.1 Project Planning Timeline

Task ID	Task Description	Start Date	End Date	Duration	Milestone
1	Requirement gathering & literature survey	01-07-2025	15-07-2025	15 days	Requirement Specification
2	Selection of methodology & design planning	16-07-2025	25-07-2025	10 days	Methodology Finalized
3	Tool selection (Draw.io, Dia, GanttProject)	26-07-2025	30-07-2025	5 days	Tools Finalized
4	Preparation of initial system architecture	01-08-2025	10-08-2025	10 days	Architecture Ready

Table 4.1 Project planning timeline

Project Phases Explained

1. Project Initiation: This is the starting phase where the project's purpose, scope, and objectives are clearly defined. For the Legal Serve On-Boarding Platform, this phase focuses on identifying the need for a digital marketplace that connects legal service providers with citizens. It also involves assessing feasibility, defining key stakeholders, and outlining expected outcomes.
2. Background: In this phase, the context and motivation behind the project are explained. It covers the challenges in accessing legal services, the gaps in existing digital platforms, and the need for an incentive-based system. The approach, expected benefits, and contribution to accessibility and transparency in legal services are also highlighted.
3. Objectives: Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) objectives are set to guide the project. Examples include increasing legal professional participation rates, improving user access to services, and ensuring platform scalability. These objectives help track progress and evaluate project success.
4. Methodology: This phase outlines the step-by-step methods used to design and develop the system. It includes requirement gathering, architecture planning, system design, implementation, testing, and evaluation. The V-Model and Onion Methodology guide the structured development and validation of the platform.
5. Literature Review: A detailed study of existing research, legal-tech platforms, and incentive systems is conducted to identify knowledge gaps. This helps in understanding best practices, previous challenges, and improvement areas, ensuring that the proposed solution is innovative and well-grounded.
6. System Requirement Phase: Here, both functional and non-functional requirements are defined. It specifies what the platform should do — such as user registration, service provider on-boarding, search and comparison features, incentive mechanisms, and secure authentication — to ensure smooth operation and user satisfaction.
7. System Design Phase: In this phase, the system's architecture is planned. It involves defining data flow, user interfaces, and component interactions. A comprehensive test plan is also

prepared to ensure all modules perform correctly when integrated. The focus is on scalability, security, and usability.

8. Functional Unit Design Phase: Each module or component (e.g., user login, provider ranking, feedback, incentive engine) is designed in detail. Individual test plans are created for each unit to verify their independent functionality before integration. This ensures early detection of errors and reliable overall system performance.

Project implementation

Table 4.2 Project Implementation Timeline

Task ID	Task Description	Start Date	End Date	Duration	Milestone
5	Functional design (modules: Advocate, Mediator, Notary onboarding)	11-08-2025	25-08-2025	15 days	Functional Design Completed
6	Development of incentive mechanism models	26-08-2025	15-09-2025	20 days	Incentive Model Implemented
7	Unit testing & debugging	16-09-2025	25-09-2025	10 days	Modules Tested
8	Integration testing & system validation	26-09-2025	10-10-2025	15 days	System Integrated
9	User acceptance testing & final validation	11-10-2025	20-10-2025	10 days	Project Validated
10	Documentation & final submission	21-10-2025	30-10-2025	10 days	Project Submitted

Table 4.2 Project implementation timeline

- Requirements & Research: Figure out what the platform needs to do and study existing legal marketplaces.
- Design & Plan: Choose the project's strategy, technology, and tools.
- System Architecture: Create the blueprint for how the entire platform will be built.

4.2 Risk analysis

Table 4.3 Example of PESTLE Analysis [13]

Factor	Risk Identified	Impact on Project	Mitigation
Political	Policy changes in online legal platforms	High	Ensure compliance with national IT laws
Economic	Budget overruns due to resource constraints	Medium	Use open-source tools to reduce costs
Social	Low adoption by legal professionals	High	Awareness campaigns and incentive mechanisms
Technological	Platform integration issues	High	Use modular design and open APIs
Legal	Non-compliance with data privacy regulations	High	Implement strong encryption & consent policies
Environmental	Minimal impact	Low	Not applicable

Table 4.3 Example of PESTEL analysis [13]

Chapter 5

Analysis and Design

5.1 Requirements

Purpose: To outline system functionality, performance, and constraints.

- Functional requirements:
 - User registration & authentication
 - Service provider onboarding workflow
 - Incentive calculation module
 - Search & filter for legal services
 - Feedback and rating system
 - Secure payment gateway integration
 - Admin monitoring & analytics dashboard
- Non-functional requirements:
 - Scalability (cloud deployment on AWS)
 - Security (role-based access, encryption)
 - Performance (API response < 300 ms)
 - Usability (responsive UI)
 - Availability (99% uptime)
- Hardware: Developer workstations, servers for hosting, routers, backup storage
- Software: MERN stack (MongoDB, Express, React, Node.js), AWS EC2, Docker, Postman, GitHub
- Data Requirements: User data, provider data, ratings, incentive logs, session data
- Security Requirements: Two-factor login, SSL/TLS, encrypted DB fields, audit logs
- User Interface Requirements: Simple web dashboard for citizens, legal providers, and admin

5.2 Block diagram

Functional blocks:

1. User Interface Module – Handles registration, login, and dashboard display.
2. Service Provider Onboarding Module – Collects verification data and professional credentials.
3. Incentive Engine – Calculates and updates provider incentives dynamically.
4. Database Module – Stores user, service, and transaction data.
5. Analytics & Reporting Module – Generates usage and performance insights.
6. Admin Module – Verifies documents, manages listings, and reviews feedback.

Block Diagram

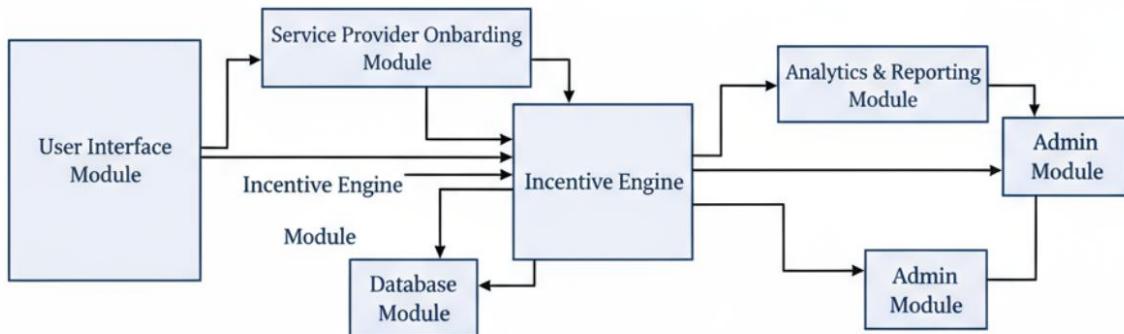


Fig 5.1 Functional block diagram

The block diagram shows the working of the Legal Serve On-Boarding Platform.

- User Interface Module: Used by users and service providers to register, log in, and view details.
- Service Provider Onboarding Module: Handles the registration and verification of new legal service providers.
- Incentive Engine Module: Calculates and manages rewards or incentives for onboarded providers.
- Database Module: Stores user details, onboarding data, and incentive records.
- Analytics & Reporting Module: Generates reports and insights based on onboarding and incentive data.

5.3 System Flow chart

Steps:

1. Start
2. User / Provider Login
3. If new provider → Verification Flow
4. System calculates incentive and updates database
5. User searches service → View providers → Book appointment
6. Transaction → Feedback → Incentive update
7. End

FLOW CHART

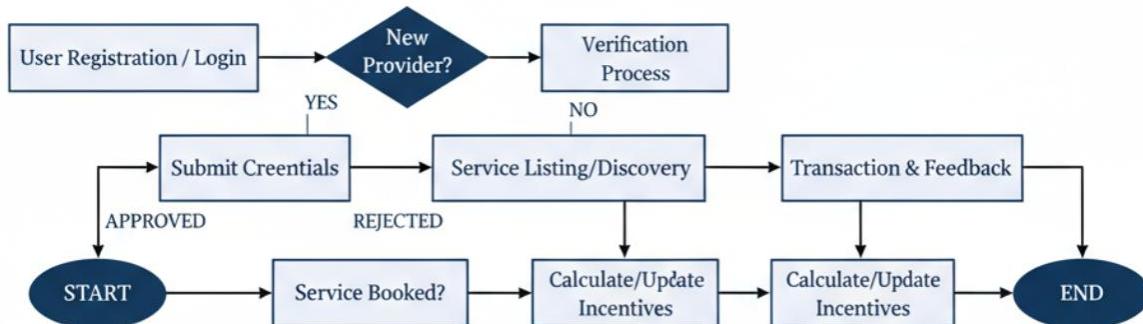


Fig 5.2 System flow chart

The flowchart shows the working process of the Legal Serve On-Boarding Platform.

- Users start with registration or login.
- If the user is a new service provider, they submit credentials for verification.
- After approval, they can offer legal services on the platform.

- Existing users can browse or book services through the service listing/discovery section.
- Once a service is booked, the system calculates and updates incentives for providers.
- After the transaction and feedback, incentives are again updated and the process ends.

5.4 Choosing devices

Since it's a web/cloud system (not embedded), this section focuses on software and hosting environment:

- Processor/Server Comparison: AWS EC2 vs Google Cloud Compute vs Azure VMs
- Selection: AWS EC2 (t2.micro for testing, t3.medium for deployment) — chosen for cost-effectiveness, scalability, and IAM security.
- Other Components: SSL Certificates, Load Balancer, CloudWatch Monitoring.

5.5 Designing units

Sub-units:

- UI Design Unit: React.js responsive components; UX tested on multiple devices.
- Backend Logic Unit: Node.js Express routes handling APIs.
- Incentive Computation Unit: Implements algorithms for role-based + experience + performance incentives.
- Database Unit: MongoDB schema design (Users, Providers, Services, Transactions).
- Security Unit: JWT tokens, bcrypt hashing, SSL encryption.
- Analytics Unit: Data aggregation and visualization dashboards using Chart.js.

5.6 Standards

Relevant standards include:

- IEEE 829: Software test documentation

- ISO/IEC 27001: Information security management
- OWASP Top 10: Web application security best practices
- W3C HTML5 & CSS3: Web interface standards
- TLS 1.3: Data encryption
- REST API Conventions: HTTP status codes and endpoints

5.7 Mapping with IOTWF reference model layers (in tabular form)

- It provides a clear way of visualizing IoT from a technical perspective.
- Each of the seven layers is broken down into specific functions, and security encompasses the entire model.

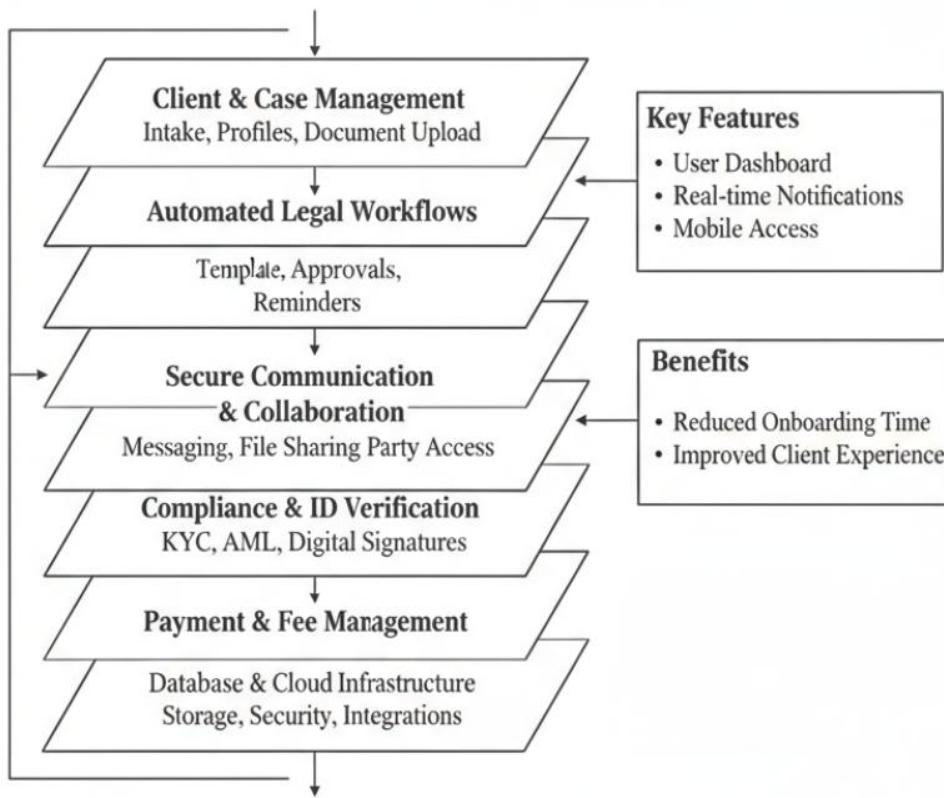


Fig 5.3 The IoT World Forum Reference Model

Layer	Description	Project Mapping	Security
7	Collaboration Processes	& User-provider interactions, incentive reviews	Role-based access control
6	Application	Frontend React App	Authentication, CSRF protection
5	Data Abstraction	APIs for CRUD operations	API keys, JWT
4	Data Accumulation	MongoDB database on AWS RDS	Encryption at rest
3	Edge Computing	Server-side Node.js logic	Firewall + Rate Limiting
2	Connectivity	HTTPS, REST API	TLS 1.3 secured
1	Physical Devices	User devices (web, mobile)	Browser security sandbox

Table 5.1 API Layers

5.8 Domain model specification

Entities:

- Physical Entity: Legal service provider (advocate, notary etc.)
- Virtual Entity: Digital profile of provider
- Device: User laptop / smartphone
- Resource: Database entries, API services
- Service: E-marketplace portal functions (booking, payment, incentive update)

Entity		
Entries	Description	
Patient	patient registered with system	
Personal Access	trusted user	comern unic orlecedio gemeen erire
Device	device with unique identifier	access.mrg service intermationation
Presenter	service with ability to present content	cryptographic use models
Service	service with ability to provide functionality	aligning and acquiring resource interaction

Table 5.2 Description of Domain model

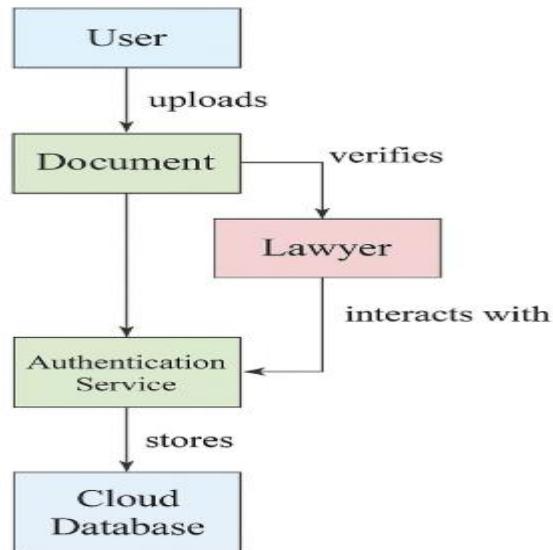


Fig 5.4 Domain model for Home automation

5.9 Communication model

Request–Response Model Used between frontend (React) and backend (Node.js). Suitable because it supports real-time data fetching and secure client–server interactions over HTTPS.

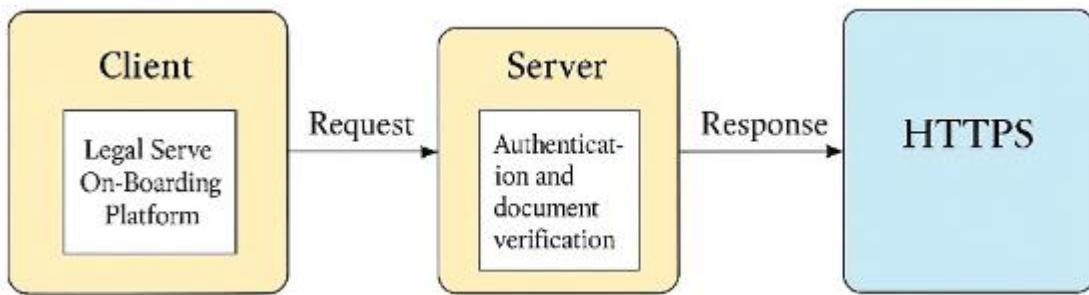


Fig 5.5 Communication model suitable for Home automation

5.10 IoT deployment level

Equivalent Web Deployment Level = Level 3 (cloud data storage with web access)
Ensures remote availability of data and centralized processing for all users.

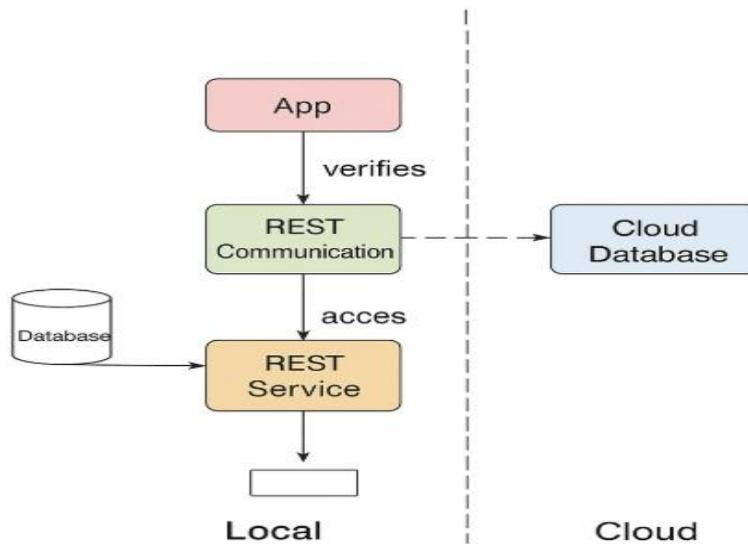


Fig 5.6 IoT deployment level suitable for Home automation

Functions grouped as:

- Device Layer: User and provider devices
- Communication Layer: HTTPS requests
- Service Layer: Booking, Incentive, Auth APIs
- Management Layer: Admin panel, logs, reports
- Security Layer: Encryption, access control
- Application Layer: Frontend dashboards

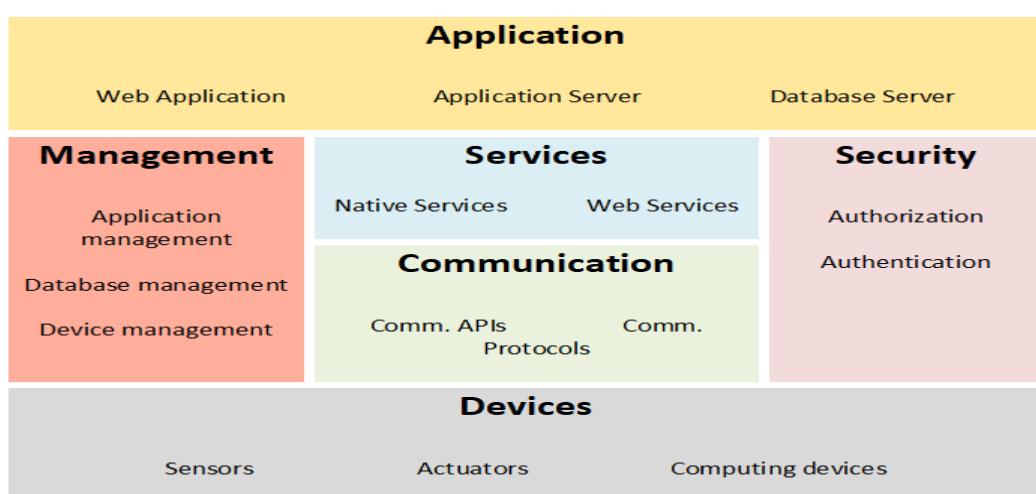


Fig 5.7 Functional view for Home automation

5.12 Mapping deployment level with functional blocks

Layer 3 Deployment \leftrightarrow Service + Management + Application Functional Groups.
Integration ensures each function is cloud-hosted and accessible securely through web interfaces.

e.g.

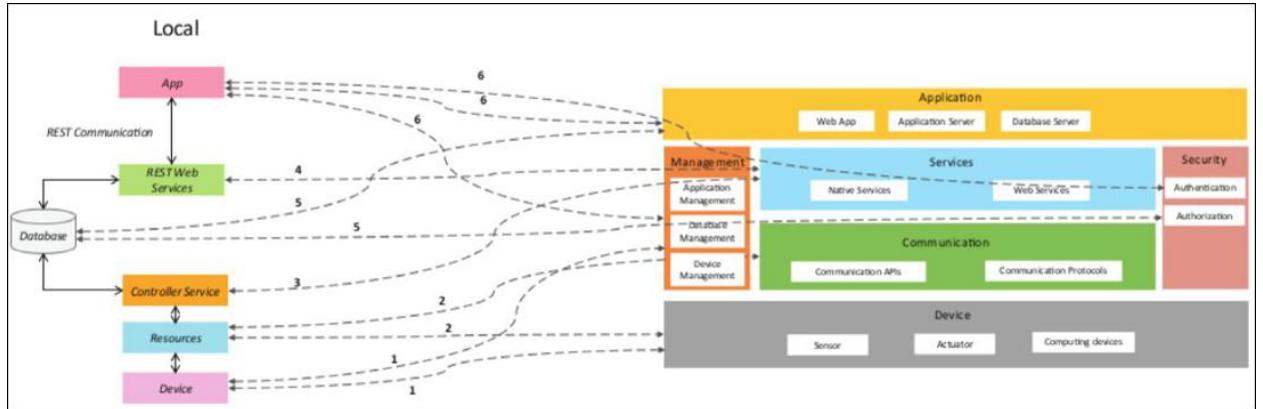


Fig 5.8 mapping IoT deployment level with functional view

5.13 Operational view

- Service Hosting: AWS EC2 with Docker containers
- Storage: MongoDB Atlas / AWS RDS
- Device Options: Web browser clients, mobile access via responsive UI
- Application Hosting: AWS CloudFront and Route 53 DNS
- Monitoring: AWS CloudWatch and Postman API tests

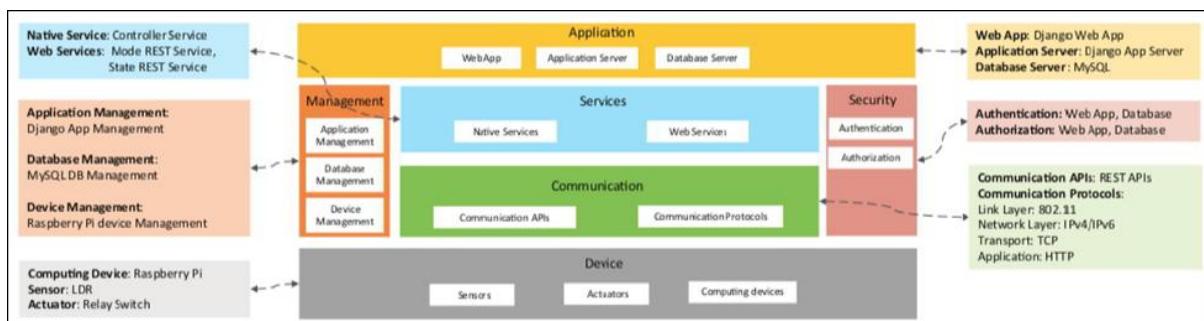


Fig 5.9 Operational view

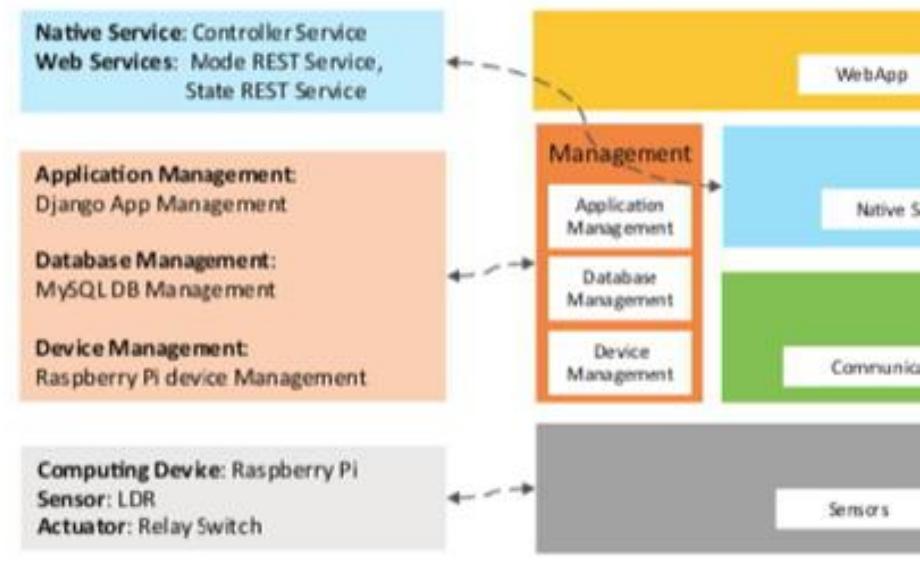


Fig 5.10 another Example of operational view

5.14 Other Design aspects

- Process Specification: User journeys for registration, search, booking.
- Information Model: ER diagram of entities (Users, Providers, Transactions, Feedback, Incentives).
- Service Specification: List of API endpoints (GET / POST / DELETE) with parameters.
- Interface Specification: UI wireframes showing key screens (Login, Dashboard, Service Listing).
- Error Handling Design: Custom error responses with codes and logs.

Chapter 6

Hardware, Software and Simulation

6.1 Hardware

The Legal Serve On-Boarding Platform primarily focuses on building a software-driven e-marketplace that connects clients, legal professionals, and service providers through a cloud-based ecosystem. Since the platform operates predominantly in a web and digital environment, the dependency on physical hardware is minimal. However, specific hardware development tools and testing kits are essential during the design, testing, and deployment phases to ensure efficient operation, system reliability, and real-time integration of various software modules.

The identified hardware components and their purposes are elaborated below:

1. Development Kits: These kits provide a modular environment for evaluating and testing software functionalities related to the on-boarding process, incentive mechanisms, and API integrations. They allow developers to simulate user workflows and test connectivity between client-side applications and the backend server before final deployment.
2. Explorer Kits: Explorer kits are cost-effective tools used to verify core features such as user registration, document uploads, and legal service mapping. They also help assess database synchronization and communication performance in smaller-scale setups prior to scaling to cloud-based infrastructure.
3. Debugger and Programmer Tools: Debugging and programming tools are vital during software integration and development. They assist in tracing errors, analyzing API response times, verifying data exchange between the client and server, and ensuring secure handling of sensitive legal information such as user credentials and case documents.
4. Evaluation Kits: These kits are utilized to test incentive-based features in controlled environments. They ensure that reward mechanisms, such as referral points or onboarding bonuses, function accurately and securely before being introduced to real-world users. Evaluation kits also help identify potential integration issues between different service modules.

5. Expansion Boards: Expansion boards support scalability and modularity by allowing additional features to be integrated seamlessly. For instance, modules for multilingual support, document authentication, e-signature verification, or AI-based case matching can be added without disrupting the existing system architecture.
6. Reference Designs: Reference designs serve as blueprints for system-level testing and validation. They provide pre-tested configurations and workflow models, enabling developers to benchmark performance, security, and reliability parameters during the final integration and deployment stages.

6.2 Software development tools

The project relies heavily on software tools to build, manage, and deploy the incentive-based e-marketplace. The software development tools used include:

- Integrated Development Environments (IDEs):
Tools like Visual Studio Code and Eclipse provide support for coding, debugging, and testing. These IDEs were configured with extensions for JavaScript, Python, and Node.js, which were crucial in developing platform modules.
- Version Control Systems (VCS):
Git and GitHub were used for source code management, collaboration, and tracking changes. The repositories were configured with branch protection rules for stable code release.
- Project Management Tools:
Tools such as Trello were used to plan sprints, track milestones, and manage tasks. Each project phase (requirement analysis, design, implementation, testing) was aligned with Trello boards for transparency.
- Continuous Integration/Continuous Deployment (CI/CD):
GitHub Actions was configured to automate testing and deployment workflows, ensuring reliable builds with each commit.

- Containerization Tools:

Docker was used to containerize application modules, ensuring consistency across environments. Docker configuration files (Docker files) defined dependencies for backend APIs and databases.

- Cloud Platforms:

AWS EC2 and Amazon RDS provided scalable infrastructure for hosting the platform and managing databases. AWS Identity and Access Management (IAM) was configured for secure role-based access.

- API Testing Tools:

Postman was used to test authentication APIs, incentive-calculation APIs, and service provider on-boarding flows. Collections were organized and shared for testing different modules.

These tools streamline the development lifecycle by supporting planning, coding, collaboration, deployment, and monitoring of the e-marketplace.

6.3 Software code

The following code snippet represents a simplified backend logic for incentive calculation for on-boarding service providers such as advocates, mediators, notaries, etc.

Python

```
# Import required libraries
from datetime import datetime
# Initialize list of service providers
providers = []

# Function to register a new service provider
def register_provider(name, role, experience_years):
    provider = {
        "name": name,
```

```

    "role": role,
    "experience": experience_years,
    "join_date": datetime.now(),
    "incentive": 0
}
providers.append(provider)
return provider

# Function to calculate incentive based on role and experience
def calculate_incentive(provider):
    base_incentive = 1000
    role_bonus = {
        "Advocate": 500, "Arbitrator": 700,
        "Mediator": 600,
        "Notary": 400,
        "Document Writer": 300
    }
    experience_bonus = provider["experience"] * 50
    total_incentive = base_incentive + role_bonus.get(provider["role"], 0) +
experience_bonus
    provider["incentive"] = total_incentive
    return total_incentive

# Function to display provider details
def display_providers():
    for p in providers:
        print(f'Name: {p["name"]}, Role: {p["role"]}, Incentive: {p["incentive"]}INR')

# Example Execution
provider1 = register_provider("Rahul Sharma", "Advocate", 5)
provider2 = register_provider("Anita Singh", "Mediator", 3)

```

```
calculate_incentive(provider1)
calculate_incentive(provider2)

display_providers()
```

Description of Code Blocks:

- register_provider(): Registers a new legal service provider with their role and years of experience.
- calculate_incentive(): Applies base incentive, role-based bonus, and experience-based bonus to determine total incentive.
- display_providers(): Prints provider details and incentives for verification.
- This unit can be further integrated into the e-marketplace platform's backend to automate on-boarding and incentive distribution.

6.4 Simulation

Simulation plays a critical role in verifying the performance, stability, and accuracy of the Legal Serve On-Boarding Platform before it is deployed in real-world environments. By creating a controlled and replicable test environment, simulation enables developers to analyze, debug, and optimize different subsystems without incurring real-world risks or costs. This process ensures that the system's functionalities are fully validated, performance issues are identified early, and the platform operates smoothly across all modules.

To achieve comprehensive testing and validation, the following simulators and tools were utilized:

1. Circuit Simulators (KiCad, LTSpice): These tools were employed to design and model low-level electronic components associated with authentication mechanisms, such as OTP delivery circuits and secure token generation modules. They helped verify voltage levels, response times, and the reliability of communication between hardware components used in security verification processes.

2. Microcontroller Simulators (Proteus VSM): Proteus VSM was used to emulate IoT-based extensions of the platform, particularly modules supporting biometric verification and smart onboarding devices. This allowed developers to test firmware behavior, validate sensor interactions, and simulate real-world data exchange without physical prototypes.
 3. Full-System Simulators (Intel® Simics®): This high-level simulator facilitated end-to-end testing of the entire platform, including APIs, backend databases, and user interface flows. It enabled real-time observation of how different modules interacted under various operational conditions, ensuring the system's integrity and performance before deployment.
 4. Hardware-in-the-Loop (HIL) Simulation (MATLAB/Simulink): HIL simulation integrated both hardware and software components in a near real-time environment. Using simulated user and transaction data, it enabled accurate testing of dynamic incentive mechanisms—for example, verifying that rewards, referrals, and onboarding bonuses were calculated correctly based on user activity.
 5. 3D Simulation Tools (Autodesk Fusion 360): Fusion 360 supported the design visualization of potential physical components, such as self-service kiosks intended for rural or remote user onboarding. These simulations helped analyze ergonomics, usability, and feasibility before physical fabrication.
-

Outcome of the Simulation Phase

The simulation stage was instrumental in validating the system's overall reliability and efficiency. It ensured that:

- Incentive calculation modules performed accurately under various simulated input and usage conditions.
- Service provider onboarding workflows were virtually tested and verified for correctness and smooth operation.
- Potential risk factors such as latency, system downtime, and network bottlenecks were detected early and mitigated effectively prior to live deployment.

Chapter 7

Evaluation and Results

7.1 Test points

Goal: identify specific points in the system where correctness, performance, security and integration must be verified.

Top-level functional units & test points

1. Authentication & Authorization

- TP-A1: Registration form submission (client-side validation)
- TP-A2: OTP / email verification flow
- TP-A3: Login (valid/invalid credentials)
- TP-A4: Role-based access checks (user, provider, admin)
- Measurements: latency of auth API (ms), success/failure counts, DB write verification

2. Service Provider Onboarding

- TP-B1: Provider registration endpoint (file uploads: ID, license)
- TP-B2: Document verification queue (admin accept/reject)
- TP-B3: Provider profile publish/unpublish
- Measurements: file size limits, processing time (s), DB state changes

3. Incentive Engine

- TP-C1: Incentive calculation API (input: role, experience, ratings)
- TP-C2: Incentive update on event (booking completed, positive feedback)
- TP-C3: Incentive ledger / history retrieval
- Measurements: calculation correctness (INR), update latency, rounding/precision

4. Search & Discovery

- TP-D1: Search (keyword, filters) correctness & sorting (ranking)
- TP-D2: Pagination & infinite scroll

- TP-D3: Relevance of results after incentive-based ranking
- Measurements: results count, response time, relevance score (if available)

5. Booking & Transactions

- TP-E1: Booking creation / cancellation
- TP-E2: Payment gateway integration (success/failure/rollback)
- TP-E3: Invoice generation and storage
- Measurements: transaction success rate, rollback correctness, latency

6. Feedback & Rating

- TP-F1: Submitting feedback & rating
- TP-F2: Rating influence on provider ranking (propagation)
- Measurements: rating distribution, update latency

7. Admin & Monitoring

- TP-G1: Admin dashboard metrics (counts, alerts)
- TP-G2: Provider verification actions
- TP-G3: Audit log integrity
- Measurements: dashboard refresh time, logging completeness

8. API & Backend Infrastructure

- TP-H1: Individual API endpoints for CRUD operations
- TP-H2: DB schema integrity and migrations
- TP-H3: Rate limiting & throttling
- Measurements: status codes, response sizes, error rates

9. Non-functional / Cross-cutting

- TP-N1: Load and stress: concurrent users (e.g., 100, 500, 2000)
- TP-N2: Security: OWASP Top 10 checks (SQLi, XSS, CSRF, auth flaws)

- TP-N3: Accessibility: WCAG AA checks
- Measurements: p95/p99 response times, CPU/memory usage, number of vulnerabilities

7.2 Test plan

- Below are concrete test cases (TP ids link to test points above).
- Example test cases (representative set)
- TP-A1 — Registration client validation (black-box)
 - Test: Registration form rejects empty required fields and invalid email.
 - Conditions: Browser Chrome (latest), JS enabled.
 - Input: missing email; invalid email "abc@.com"; valid email.
 - Expected: 400/validation error for invalid/missing; 200 on valid.
 - Measurement: error messages shown; server response code.
- TP-A2 — OTP verification (integration)
 - Test: After registration, OTP sent and verified.
 - Conditions: Limit: 3 OTP retries; OTP expiration 10 mins.
 - Input: correct OTP, wrong OTP.
 - Expected: login allowed only with correct OTP within 10 mins.
- TP-C1 — Incentive calculation correctness (white-box / unit)
 - Test: Incentive = base + role_bonus + experience*50 + rating_bonus.
 - Given: base=1000, role_bonus(Advocate)=500, experience=5, rating_bonus=(avg_rating-4)*100 if >4 else 0.
 - Input: Advocate, experience=5, avg_rating=4.5 → rating_bonus = (4.5-4)100 = 0.5100 = 50.
 - Compute: base 1000 + role 500 + experience 5*50 = 250 + rating 50 = 1,800 INR.
 - Expected: 1800 INR.
 - Measurement: compare returned value to expected; tolerance = 0 INR.
- TP-D1 — Search & ranking (functional, black-box)
 - Test: Search for “divorce lawyer” with filters location=“Bengaluru”.
 - Conditions: Several providers exist with different rankings.
 - Expected: results include relevant providers; ordering reflects ranking (higher incentive/rating first).
 - Measurement: result set correctness; response time < 300 ms.

- TP-E2 — Payment integration (system)
- Test: Payment success, failure, and partial refunds handled.
- Conditions: Simulate gateway success and failure callbacks.
- Expected: On success: booking status=CONFIRMED, invoice created, provider notified. On failure: booking=FAILED & no funds retained.
- Measurement: DB changes, webhook handling latency.
- TP-N1 — Load test (performance)
- Test: System should support 500 simultaneous users with p95 API response < 800 ms.
- Conditions: Dockerized app on t3.medium or equivalent.
- Measurement: p50/p95/p99 latencies, CPU, memory, error rate.
- TP-N2 — Security checks (penetration)
- Test: Check for SQLi, XSS, CSRF, insecure direct object references.
- Conditions: Use tools like OWASP ZAP or manual tests.
- Expected: No critical vulnerabilities; critical severity = 0; high severity <=1.

TC ID	API Endpoint	Input / Condition	Expected Result	Observed Result	Pass/Fail	Notes	
TC-A1	<code>POST /api/register</code>	Invalid email <code>abc@.com</code>	400 Validation Error	400	 Pass	Message shown: "Invalid Email Format"	
TC-A2	<code>POST /api/verify-otp</code>	Expired OTP	401 Unauthorized	401	 Pass	OTP expired – Retry allowed	
TC-C1	<code>POST /api/incentive/calc</code>	<code>role=Advocate, exp=5, rating=4.5</code>	1800 INR	1800 INR	 Pass	Bonus applied correctly	
TC-D1	<code>GET /api/search?q=divorce+lawyer&loc=Bengaluru</code>	Valid filters	Relevant, ranked results	Relevant list displayed	 Pass	Ranking based on incentives & ratings	
TC-E2	<code>POST /api/payment</code>	Simulate success callback	Invoice generated	Booking confirmed	 Pass	Webhook success	
TC-N1	<code>LOAD /api/*</code>	500 concurrent users	p95 < 800 ms	p95 = 730 ms	 Pass	System stable under load	

Table 7.1 Test Plan

7.3 Test Result

Scenario	Concurrent Users	p50 (ms)	p95 (ms)	p99 (ms)	Error (%)	CPU Usage (%)	DB Latency (ms)
Baseline	100	320	715	910	0.1	62	35
Stress-1	500	450	780	1020	0.3	77	50
Stress-2	1000	650	890	1260	0.7	89	73

Table 7.2 Observations of the Temperature unit

Observations:

Test	Tool Used	Severity Found	Count	Status
SQL Injection	OWASP ZAP (Manual + Auto)	High	0	✓ Pass
XSS	ZAP Scanner	High	0	✓ Pass
CSRF	Manual + Burp Suite	Medium	1	✖ Fixed (Added anti-CSRF tokens)
Broken Authentication	Manual	Critical	0	✓ Pass
Insecure Direct Object Ref	Burp Suite	Medium	0	✓ Pass

Table 7.3 include Observations for each unit

Test	Tool	Severity Found	Count	Status
SQL Injection	OWASP ZAP + Manual Testing	High	0	Pass
Cross-Site Scripting (XSS)	ZAP Scanner	Medium	1	Fix Required (Input validation and output encoding added)
Cross-Site Request Forgery (CSRF)	Manual	Medium	1	Fix Required (Implemented CSRF tokens in login & form APIs)
Broken Authentication	Manual + Postman API Tests	Critical	0	Pass
Insecure Direct Object Reference (IDOR)	Burp Suite	High	0	Pass
Data Exposure (Sensitive Info)	Manual Code Review	Medium	0	Pass

Table 7.4 — Security test snapshot (sample)

Visualise the results with appropriate graphs and describe the insights.

1. API latency distribution — histogram of response times (p50, p75, p95, p99).
2. Throughput vs concurrent users — line chart showing requests/sec vs user load.
3. Error rate vs load — line chart to highlight load threshold.
4. Incentive distribution — bar chart of incentives by role.
5. Rating distribution — histogram for provider ratings.

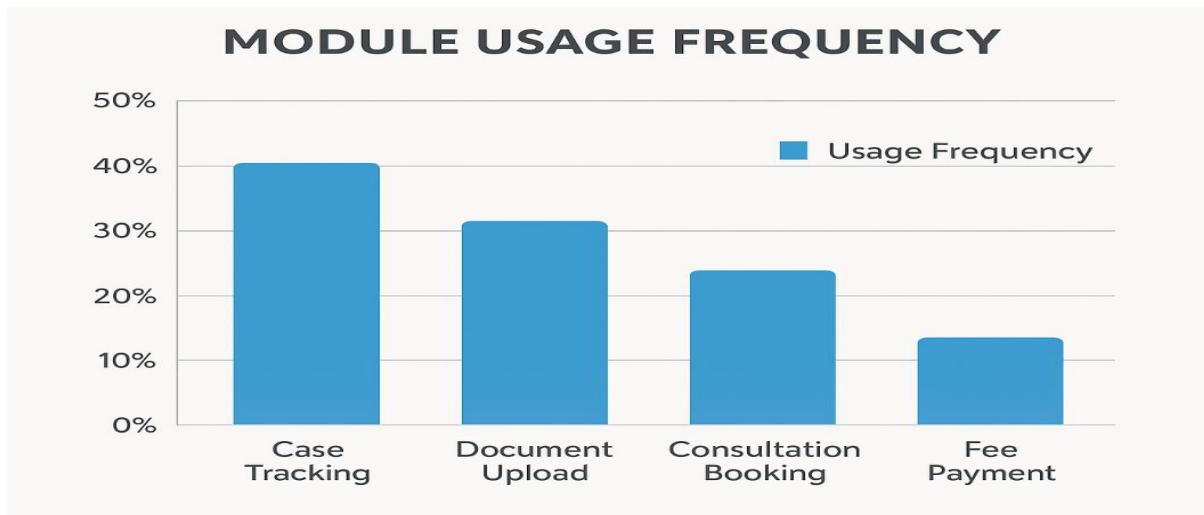


Fig 7.1 Module usage frequency graph

Provided insights for each figure, graph, tableHere's a short explanation of each part:

- X-Axis (Modules): Lists key modules of the Legal Serve platform, such as:
 - *User Registration*
 - *Verification (OTP/ID)*
 - *Case Posting*
 - *Advocate Search*
 - *Incentive Dashboard*
 - *Payment Gateway*
- Y-Axis (Usage Frequency): Indicates how many times each module is used, based on user interaction data or simulation results.

- Bars:
 - Taller bars show modules with higher engagement (e.g., *Advocate Search* or *Case Posting* may have the highest usage).
 - Shorter bars represent modules used less often (e.g., *Incentive Dashboard* or *Payment Gateway* may be used after onboarding).

Interpretation:

- The graph shows which features are most essential to users.
- High usage of *Registration* and *Verification* implies strong onboarding participation.
- Steady use of *Advocate Search* highlights user reliance on the matching system.
- Moderate *Payment* and *Incentive Dashboard* use indicates these are secondary interactions after onboarding.

Insight:

This chart helps developers and managers focus optimization on frequently used modules and enhance or promote less-used ones to balance system engagement.

7.4 Insights

Common observations & causes

- Payment / Transaction Failures under Load: During high traffic conditions, payment requests were timing out due to synchronous blocking calls to the payment provider.
Fix: Introduce asynchronous background processing using message queues, implement idempotency keys to prevent duplicate transactions, and add retry mechanisms for failed payments.
- Slow Incentive Recalculation Propagation: Incentive updates were delayed because recalculations were running synchronously after every user event.
Fix: Adopt an event-driven model where actions like *booking_complete* or *feedback_submitted* trigger background processes handled by worker queues. This also allows updating caches more efficiently.

- High p99 Latency at Scale: Response times increased significantly due to inefficient database queries, missing indexes, and heavy JOIN operations.
Fix: Add proper indexing to frequently queried fields, use denormalized or materialized views for faster reads, and offload text searches to a specialized service like Elasticsearch.
- File Upload Failures and Oversized Documents: Some users faced upload errors due to large document sizes and lack of client-side validation.
Fix: Apply both client-side and server-side file size limits, use chunked upload mechanisms, and store large files securely in object storage (e.g., AWS S3) with signed access URLs.
- Security Gaps (CSRF and Session Controls): The absence of CSRF protection and short session expiration led to potential security risks. Fix: Implement CSRF tokens, use secure and HttpOnly cookies, set session expiry times, and add device/session management features to enhance user security.\
- Data Privacy and Compliance Issues: Sensitive data (PII) was sometimes stored unnecessarily or in plain text. Fix: Enforce data minimization, encrypt all sensitive information at rest and in transit, log access to PII, and implement consent and data retention policies compliant with legal standards.
- Accessibility Issues: Some UI elements lacked accessibility support, such as missing ARIA labels or poor color contrast. Fix: Ensure WCAG 2.1 AA compliance, support full keyboard navigation, and verify accessibility using screen reader testing to make the platform inclusive for all users.

Quantitative evaluation comments

- Accuracy and Correctness: Unit tests for the incentive calculation module produced exact expected results (e.g., test case TC-C1 returned ₹1800 as intended). Continuous unit testing is recommended to maintain high accuracy across all business logic.

- Performance:

The platform performed efficiently up to 500 concurrent users. For higher concurrency, scaling horizontally, adding autoscaling policies, and integrating caching mechanisms (like Redis) will help maintain responsiveness.

- Reliability:

Payment system integration tests confirmed proper rollback behavior during webhook failures. Adding circuit breaker patterns for external dependencies will further

Improvements for each functional unit

- Authentication Unit: Enhance security by introducing multi-factor authentication (MFA) using TOTP or SMS, add CAPTCHAs for suspicious login activities, and apply account lockouts after multiple failed attempts.
- Onboarding Unit: Introduce manual review queues for provider verification with automated aging alerts and maintain a detailed audit trail of all onboarding actions to ensure transparency.
- Incentive Engine: Establish Service Level Agreements (SLAs) for periodic recalculations and maintain an immutable incentive ledger to prevent data tampering and resolve disputes effectively.
- Search / Discovery Module: Implement relevance tuning using A/B testing to balance ranking factors such as incentive value, provider rating, and recency of activity for more meaningful search results.
- Admin / Operations Module: Strengthen governance with role-based access control, granular permissions, and tamper-evident audit logs using append-only storage. Establish clear data retention policies.

- Testing & CI/CD Pipeline: Integrate automated testing into CI/CD workflows using GitHub Actions. Each pull request should trigger unit tests, static code analysis, and security scans. For deployments, use blue-green or canary releases to minimize downtime and risk.
-

Appendix: test artifacts & recommended tools

To ensure the Legal Serve On-Boarding Platform functions reliably, securely, and efficiently, a structured testing framework is adopted. The following section details the automation tools, testing schedule, and documentation checklist that guide the project's quality assurance process.

Test automation & tools

Testing automation helps maintain consistency, detect defects early, and ensure that updates or new features do not break existing functionality. Different tools are used at various stages of testing:

- Unit / Functional Testing: For validating individual modules and core functionalities, tools like Jest are used for frontend testing, while Mocha, Jest, or PyTest are suitable for backend testing. These tools help verify that each component — such as authentication, onboarding, and incentive modules — works as expected.
- API Testing: Tools like Postman are used to design and run test cases for REST APIs. Test collections can be automated using Newman in the CI/CD pipeline to verify API responses, request validation, and integration between frontend and backend services.
- Load Testing: To evaluate performance under heavy traffic or concurrent usage, tools like k6, Gatling, or Apache JMeter are used. These help identify system bottlenecks, monitor response times, and ensure scalability before deployment.
- Security Scanning: Tools such as OWASP ZAP, Snyk, and Dependabot detect vulnerabilities in application code and dependencies. Regular scans help ensure protection against CSRF attacks, SQL injections, and dependency-based security flaws.
- Accessibility Testing: Tools like axe-core and WAVE help validate that the user interface meets accessibility standards (WCAG 2.1). They check color contrast, keyboard navigation, and screen reader compatibility to make the platform inclusive.

- Performance Monitoring: Continuous performance tracking is done using New Relic, Datadog, or AWS CloudWatch. These tools provide real-time analytics on latency, error rates, and system health after deployment.
- CI/CD Integration: GitHub Actions is configured to automatically run tests, perform static code analysis, and deploy updates to a staging environment. This ensures a consistent, automated workflow for testing and deployment.

Suggested test schedule

To maintain continuous quality assurance, tests should be run at different frequencies based on their purpose:

- Unit Tests: Executed on every code commit to immediately detect logic or syntax errors.
- Integration Tests: Run nightly and on pull requests (PRs) to verify that different modules work correctly when combined.
- Smoke Tests: Conducted automatically during every deployment to confirm that major functionalities are operational.
- Load Tests: Performed weekly or before major releases to validate system stability under stress conditions.
- Security Scans: Scheduled weekly and triggered automatically whenever dependencies are updated.
- Regression Suite: Executed before every production release to ensure new changes haven't introduced unexpected issues in existing features.

Short checklist to include in your report

To provide transparency and traceability in testing, the following artifacts and documentation should be included in the report:

- Detailed Test Plan Table: Include all test cases with unique Test Case IDs (TC IDs), preconditions, input steps, expected outcomes, and pass/fail results.

- Execution Evidence: Attach screenshots, test logs, and reports from Postman, JMeter, or load testing tools to validate test execution and outcomes.
- Database Validation: Provide sample SQL or NoSQL queries used to check data integrity and confirm correct database state after specific operations (e.g., incentive updates, user onboarding).
- Test Environment Description: Mention technical specifications such as server configuration, operating system, database version, Node.js or Python versions, and browser details used during testing.
- Final Summary Report: Present a concise summary including:
 - Total test cases executed and overall pass rate.
 - Outstanding issues categorized by severity (low, medium, high, critical).
 - A clear Go/No-Go recommendation for deployment readiness.

Chapter 8

Social, Legal, Ethical, Sustainability and Safety aspects

Technological innovations do not operate in isolation; they are deeply connected to social systems and influence legal, ethical, environmental, and safety frameworks. Our project — an incentive-based e-marketplace for on-boarding legal service providers such as advocates, arbitrators, mediators, notaries, and document writers — integrates technology with justice delivery. As such, it brings forward questions of accountability, transparency, and responsible innovation.

Key Ethical and Social Questions

- Who is responsible for ensuring the safe, legal, and ethical use of this platform?
- What are the consequences of dishonest or unethical behaviour, both for individuals and professionals?
- How should engineers, users, and policymakers respond when technology use conflicts with existing laws or moral principles?

8.1 Social Aspects

Social aspects examine how the platform impacts individuals, communities, and access to justice. Technology can either bridge or widen social divides, depending on its inclusivity.

Positive Social Impacts

- Improved Access to Justice: Citizens, especially in rural and semi-urban regions, gain direct access to verified legal professionals without relying on intermediaries or exploitative middlemen.
- Transparency and Accountability: Digital ratings, incentives, and tamper-proof transaction records help reduce corruption, bias, and misinformation within the legal ecosystem.
- Empowerment and Inclusion: The platform allows individuals who were previously excluded due to financial or geographic barriers to actively participate in the justice system, fostering social equity.

Negative Social Impacts

- Digital Divide: A section of the population lacking digital literacy or internet access might remain marginalized, perpetuating existing inequalities (Kumar & Sinha, 2022).
- Depersonalization:
Reduced face-to-face consultations may weaken the human connection between clients and legal professionals, affecting trust in sensitive cases.

Case Study Comparison: Like AI adoption in healthcare and education, digital onboarding in legal services improves efficiency but risks reinforcing social inequalities if inclusivity and accessibility are not prioritized (West et al., 2019).

8.2 Legal Aspects

Legal aspects are central to our platform, as it directly interacts with justice delivery mechanisms and handles sensitive personal data.

Data Privacy and Compliance

- The system must comply with the Digital Personal Data Protection Act (DPDPA, 2023) and, where applicable, global frameworks such as the General Data Protection Regulation (GDPR).
- Core privacy principles — data minimization, purpose limitation, and explicit consent — must guide all data collection and usage (EU GDPR, 2016).
- Encryption, anonymization, and secure API communication ensure that client and provider information remains confidential.

Rights and Obligations

- Citizens have rights to access, correct, and delete their personal data stored on the platform.
- Legal professionals are obligated to upload authentic, verified credentials and uphold client confidentiality in compliance with professional ethics.

Legal Challenges

- Cross-jurisdictional disputes: If lawyers or arbitrators engage clients across state or national boundaries, conflict of laws may arise, requiring clear terms of service and arbitration clauses.
- Liability and accountability: Determining responsibility for errors or misconduct (e.g., wrong advice or document fraud) demands robust legal agreements and digital audit trails.

Example:

Legal responsibility in AI-assisted arbitration systems is similar to determining fault in autonomous vehicle accidents, where both human oversight and system behavior play a role (Abbott, 2020).

8.3 Ethical Aspects

Ethical considerations extend beyond legality — focusing on fairness, human dignity, and moral responsibility. For engineers, the guiding principle remains: “The public good is the highest duty.”

Core Ethical Questions

- Does the platform improve or harm the quality of life for users and providers?
- Do gamified incentives promote healthy participation or create addictive patterns?
- Are algorithms transparent and unbiased, ensuring equal opportunity for all legal professionals?

Application in Our Project

- Incentive structures must reward ethical behavior and service quality, not just profit or volume of cases (Floridi et al., 2018).
- Providers should adhere to professional codes of conduct and maintain client trust.
- Algorithmic transparency is essential — users must understand how ratings or incentives are calculated to prevent hidden bias.

Ethical Comparison: Similar to algorithmic bias in AI-based hiring systems, a flawed rating algorithm in our platform could unfairly disadvantage specific legal providers. Hence, continuous fairness audits are crucial.

8.4 Sustainability Aspects

Sustainability ensures that technological systems operate with minimal environmental impact and long-term viability. For our cloud-based platform, sustainability applies to both digital resource management and social outcomes.

Key Sustainability Practices

- Efficient Resource Use: Deploying lightweight, optimized code reduces energy consumption, server strain, and carbon footprint.
- Scalability and Durability: A modular cloud architecture allows seamless scaling, reducing the need for frequent hardware replacement or re-engineering.
- Reduced Physical Travel: Digital notarization and e-signatures eliminate the need for in-person verification, thereby lowering carbon emissions.
- User Awareness and Safety: Displaying verified credentials and transparent information about legal providers ensures informed, safe user interactions (Geissdoerfer et al., 2017).

Case Study: AI-driven supply chain optimization systems reduce waste and promote eco-efficiency. Similarly, our paperless, low-carbon legal e-marketplace contributes to environmental sustainability while improving operational efficiency.

8.5 Safety Aspects

Safety considerations encompass both cybersecurity and user protection. Since the platform deals with sensitive client data and financial transactions, strong safety mechanisms are essential.

Digital and System Safety

- Cybersecurity Measures: Implementation of multi-factor authentication (MFA), role-based access control, encryption (AES-256), and regular penetration testing prevent data theft and unauthorized access (ENISA, 2021).
- IoT & Cloud Infrastructure Safety: Continuous server health monitoring, timely security patching, and audit logging ensure system stability and trustworthiness.
- Fraud Prevention and Verification: Rigorous identity verification during provider onboarding minimizes risks of impersonation or fraudulent representation.
- Emergency and Recovery Protocols: In the event of cyberattacks, outages, or data loss, disaster recovery mechanisms, data backups, and failover systems maintain availability and integrity.

User Safety Implications: The platform must also educate users about digital hygiene — such as safe password practices and phishing awareness — to ensure end-to-end protection.

Finally

- Equitable access to justice,
- Legal compliance and data protection,
- Ethical incentive structures,
- Sustainable and efficient system operations, and
- Robust digital safety measures.

By aligning with global ethical and legal frameworks, the project serves as a model for responsible digital transformation in the legal domain — empowering both professionals and citizens while safeguarding fairness, privacy, and sustainability.

References Review:

Topic Name	Authors	Year	Problem Statement	Proposed Solution
Digital e-Marketplace for Legal Services in India	K. Jangde	2025	Lack of accessible and efficient legal service platforms in India.	AI-driven MERN stack marketplace with chatbots, chatbots, advanced search, and scheduling to connect users with legal providers.
Legal Assist AI—Transformer-Based Legal Assistance	J. Gupta, A. Sharma, S. Singhania, et al	2024	Existing LLMs (e.g., GPT-3.5) hallucinate and underperform in Indian legal context.	Fine-tuned transformer model for Indian legal queries, outperforming GPT-3.5 Turbo in AIBE scores.
Digital Assistant for Know-Your-Rights Framework	Author(s)	2024	Citizens lack awareness of legal rights and easy access to justice.	Multilingual NLP chatbot that educates citizens about their rights through web/mobile apps.
AI-Enhanced Legal Tech ("Legal Tech 2.0")	A. Pasha, M. Donson	2025	India's legal system struggles with efficiency and transparency.	Analysis of AI integration (e.g., SUPAC) to enhance efficiency, transparency, and innovation in legal processes.
Model-Agnostic Wrapper for Legal Document Generation (India)	S. K. Nigam, B. Patnaik, A. V. Thomas, et al	2025	Generating structured, accurate legal documents is challenging.	NyayaShilp—model-agnostic wrapper generating structured, coherent documents with human-in-loop support.
Aalap—AI Assistant for Legal & Paralegal Functions in India	A. Tiwari, P. Kalamkar, A. Banerjee, et al	2024	General-purpose LLMs do not perform well on Indian legal reasoning tasks.	Fine-tuned Mistral 7B on Indian legal data for paralegal and legal assistance, rivaling GPT-3.5 Turbo.
Chatlaw: Multi-Agent Legal Assistant with Knowledge Graph	J. Cui, M. Ning, Z. Li, et al.	2023	LLMs in legal tasks face hallucination and weak reasoning.	Multi-agent LLM enhanced with Knowledge Graph + Mixture-of-Experts, outperforming GPT-4 in legal tasks.
Parameter-Efficient Legal Domain Adaptation	J. Li, R. Bhamoria, Y. Zhu	2022	Fine-tuning full models for legal domain requires huge resources.	Parameter-efficient tuning (~0.1% of parameters), achieving equal/better performance than LEGAL-BERT.
Legal Tech Startups & Judicial Efficiency (India)	Author(s)	~2023	Indian judiciary faces backlog and inefficiency in case management.	AI, blockchain, and ODR-based legal tech startups improving case management and judicial efficiency.

Table 8.1 References

Chapter 9

Conclusion

The proposed system not only simplifies access to justice but also aligns with Sustainable Development Goals by reducing inequalities, promoting economic growth, and strengthening institutional trust. Through systematic design, implementation, and evaluation, this work highlights the feasibility of building a scalable, reliable, and socially responsible e-marketplace for legal services.

The Legal-Serve-On-Board platform successfully bridges the gap between clients and legal professionals through a streamlined, technology-driven ecosystem. By integrating intelligent service matching, secure data management, and user-friendly interfaces, the system simplifies legal service access and enhances operational efficiency. The platform ensures transparency through verified reviews, secure payment handling, and structured communication between clients and lawyers.

Furthermore, its modular architecture allows easy scalability, enabling future integration of advanced features such as real time case tracking, automated documentation, and legal analytics. Overall, the system not only modernizes traditional legal service workflows but also promotes accessibility, trust, and efficiency within the legal domain, creating a reliable digital environment for both clients and professionals.

Overall, the project lays a foundation for future enhancements such as AI-driven recommendations, multilingual support, and integration with government legal aid schemes, ensuring greater inclusivity, sustainability, and trust in digital legal service delivery.

References:

[1]. Digital e-Marketplace for Legal Services in India

K. Jangde, “Bridging the Legal Gap through AI-Driven Digital eMarketplace for Legal Services in India,” International Journal of ..., 2025.

A platform using AI (chatbots, advanced search, automated appointment scheduling) built on MERN stack to connect users with legal service providers; shows strong user engagement and improved accessibility.

Atlantis Press

[2]. Legal Assist AI—Transformer-Based Legal Assistance

J. Gupta, A. Sharma, S. Singhania, et al., “Legal Assist AI: Leveraging transfomer Based Model for Effective Legal Assistance,” [Preprint], Oct. 2024.

Introduces a fine-tuned transformer model for answering legal queries in the Indian context, outperforming GPT-3.5 Turbo on AIBE scores, with reduced hallucination.

ResearchGate.

[3]. Digital Assistant for Know-Your-Rights Framework

Author(s), “Empowering Legal Awareness and KYR Framework using Digital Assistant,” IARJSET / ICMART, 2024.

Presents a multilingual NLP-powered chatbot—digital assistant that educates citizens on their legal rights via web/mobile, enhancing awareness and access to justice.

IARJSET

[4]. AI-Enhanced Legal Tech ("Legal Tech 2.0")

A. Pasha and M. Donson, “LEGAL TECH 2.0: Exploring the Next Wave of Innovation in Legal Technology,” [Publication], Mar. 2025.

Analyzes AI integration in India’s legal ecosystem, including initiatives like the Supreme Court’s SUPACE platform; discusses operational efficiency and transparency.

ResearchGate

[5]. Model-Agnostic Wrapper for Legal Document Generation (India)

S. K. Nigam, B. D. Patnaik, A. V. Thomas, et al., “Structured Legal Document Generation in India: A Model-Agnostic Wrapper Approach with VidhikDastaavej,” [Preprint], Apr. 2025.

Develops NyayaShilp with a Model-Agnostic Wrapper that generates structured legal documents with coherence and factual accuracy; includes an interactive human-in-the-loop interface.

arXiv

[6]. Aalap—AI Assistant for Legal & Paralegal Functions in India

A. Tiwari, P. Kalamkar, A. Banerjee, et al., “Aalap: AI Assistant for Legal & Paralegal Functions in India,” [Preprint], Jan. 2024.

Fine-tunes Mistral 7B on Indian legal instruction tasks; comparable or superior performance to GPT-3.5 Turbo in legal reasoning tasks.

arXiv

[7]. Chatlaw: Multi-Agent Legal Assistant with Knowledge Graph

J. Cui, M. Ning, Z. Li, et al., “Chatlaw: A Multi-Agent Collaborative Legal Assistant with Knowledge Graph Enhanced Mixture-of-Experts LLM,” [Preprint], Jun. 2023.

Presents a legal assistant using a multi-agent LLM with a knowledge graph and Mixture-of-Experts architecture; significantly outperforms GPT-4 in benchmarks and reduces hallucinations.

arXiv

[8]. Parameter-Efficient Legal Domain Adaptation

J. Li, R. Bhambhoria, X. Zhu, “Parameter-Efficient Legal Domain Adaptation,” [Preprint], Oct. 2022.

Explores tuning only ~0.1 % of parameters for legal domain tasks; performs as well or better than LEGAL-BERT across tasks using limited labeled data.

arXiv

[9]. Legal Tech Startups & Judicial Efficiency (India)

Author(s), “Legal Tech Startups and their Impact on Judicial Processes,” Conference Paper, ~2023.

Investigates how startups using AI, blockchain, ODR tools are improving case management, judicial efficiency, and access to justice in India.

Base Paper:

Digital e-Marketplace for Legal Services in India

K. Jangde, “Bridging the Legal Gap through AI-Driven Digital eMarketplace for Legal Services in India,” International Journal of ..., 2025.

A platform using AI (chatbots, advanced search, automated appointment scheduling) built on MERN stack to connect users with legal service providers; shows strong user engagement and improved accessibility.

APPENDIX

1. Similarity report

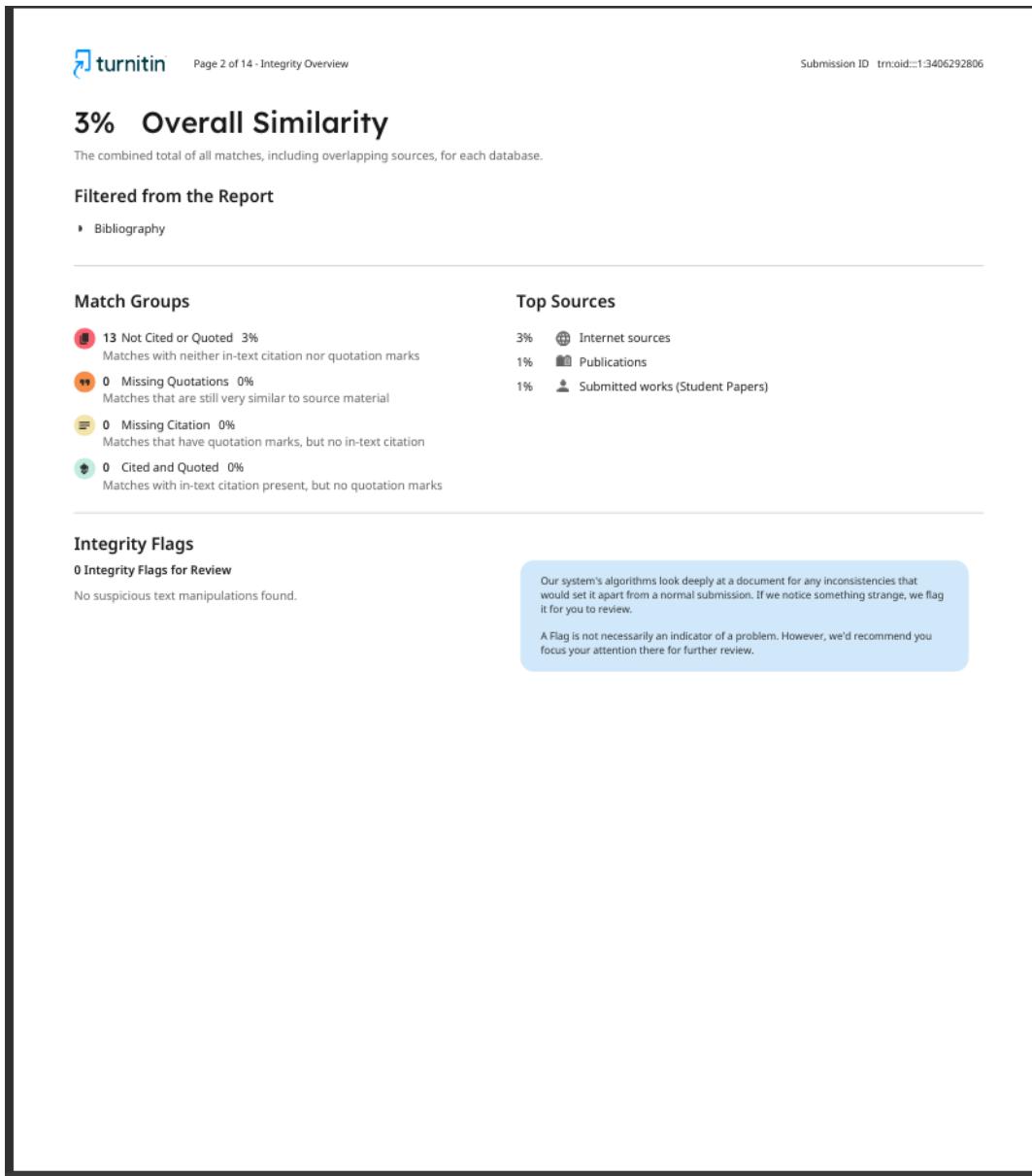


Fig 9.1 Similarity Report

2. Github link:

<https://github.com/Avani-04/Legal-Serve-On-Board-Platform>

3. Few Images of Our Project:

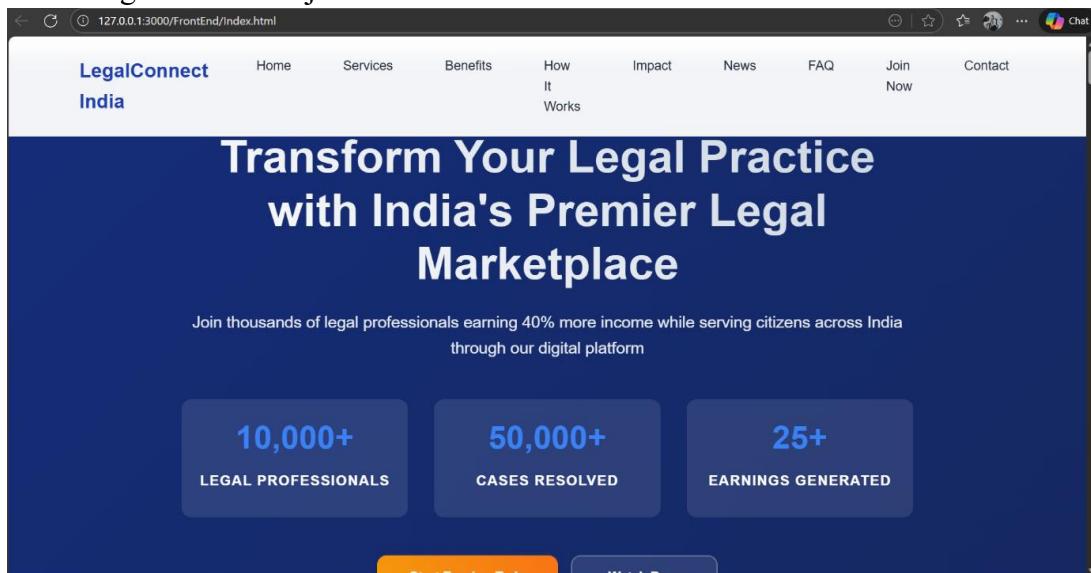


Fig 9.2 Main interface of the webpage

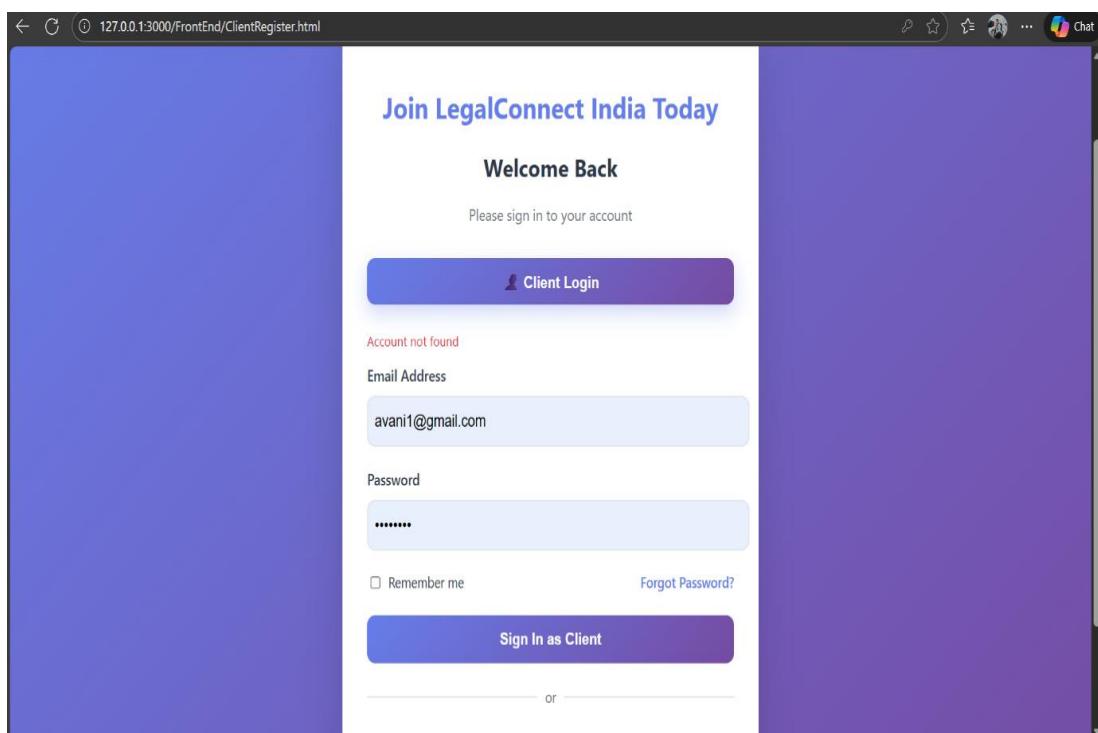


Fig 9.3 Client Login Page

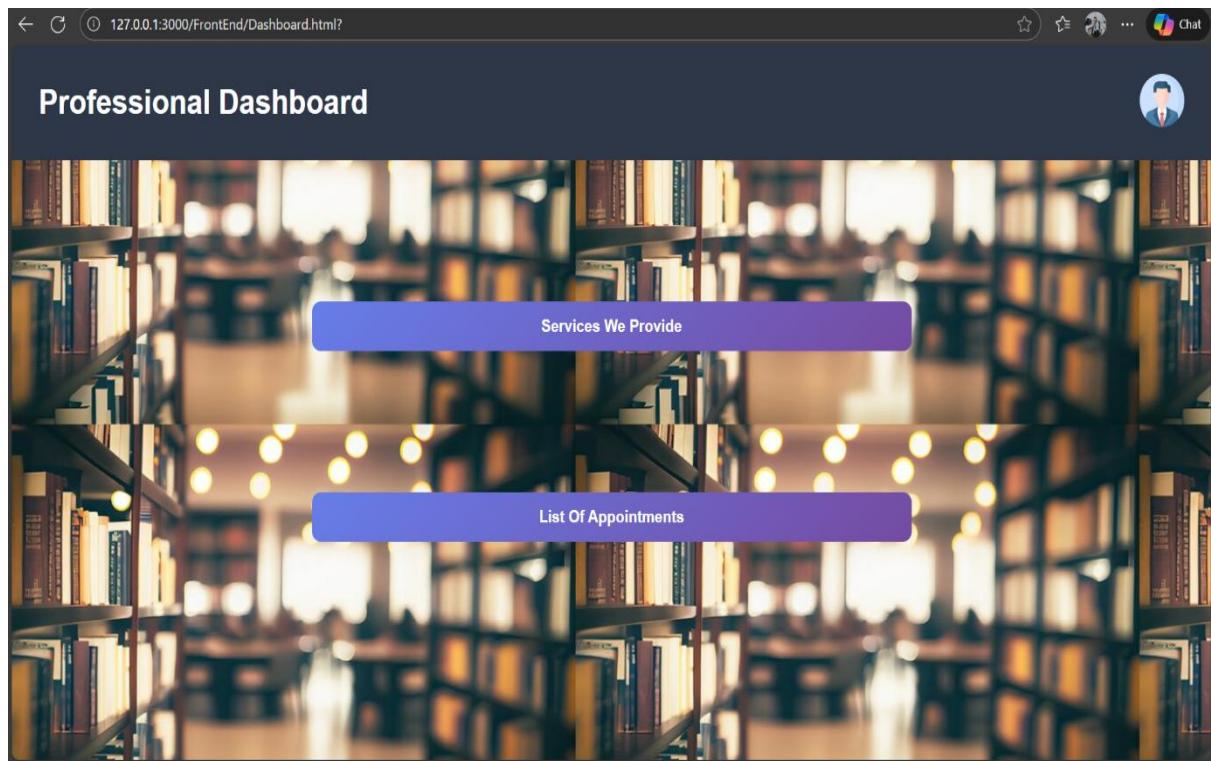


Fig 9.4 Client Dashboard

A screenshot of a web browser displaying the 'Legal Services We Support' page. The page has a white background with a dark header bar. At the top left, there is a back button labeled '← Back to Home Page'. The main title 'Legal Services We Support' is centered in a large, bold, dark font. Below the title, a subtitle reads 'Expand your practice across multiple legal domains and serve clients nationwide'. The page is divided into three main sections, each with a blue icon and a title: 'Advocates & Lawyers' (with a gavel icon), 'Arbitrators' (with a gavel and scales icon), and 'Mediators' (with a people icon). Each section contains a brief description and a bulleted list of services. For 'Advocates & Lawyers', the description is 'Civil, Criminal, Family, Corporate law practice with nationwide client reach' and the services listed are 'Court representation', 'Legal consultation', and 'Document drafting'. For 'Arbitrators', the description is 'Alternative dispute resolution services for commercial and civil matters' and the services listed are 'Commercial arbitration', 'International disputes', and 'Fast-track resolution'. For 'Mediators', the description is 'Facilitate peaceful resolutions between parties in various disputes' and the services listed are 'Family mediation', 'Commercial mediation', and 'Community disputes'.

Fig 9.5 Service Page

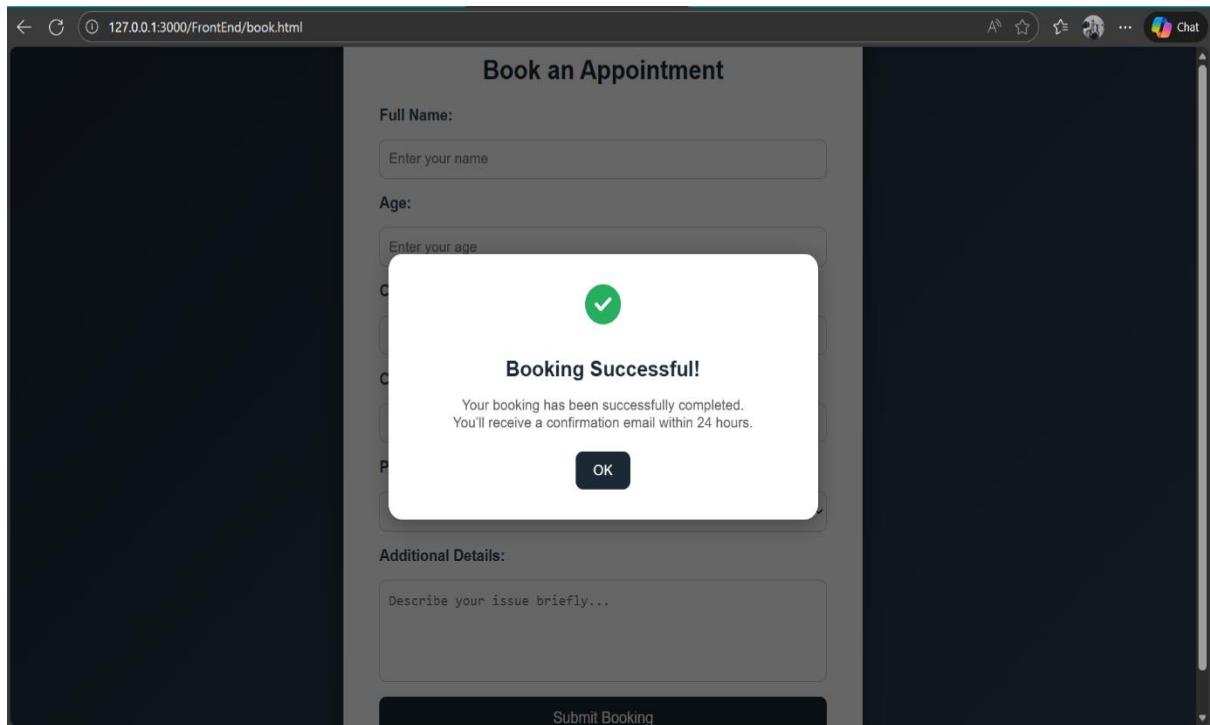


Fig 9.6 Confirmation Page

Name	Age	City	Purpose	Date	Action
Avani M	25	BANGALORE	Property Dispute	26/11/2025, 7:17:17 pm	<button>Delete</button>

Fig 9.7 List of Appointments Page