AYUSH STARTUP REGISTRATION PORTAL

A PROJECT REPORT

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50 YEARS

PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
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We the students of final year B.Tech in COMPUTER SCIENCE ENGINEERING at Presidency University, Bengaluru, named Ghangadhar, Chandan Kumar HH, Navya Shree E, hereby declare that the project work titled **"AYUSH Startup Registration Portal"** has been independently carried out by us and submitted in partial fulfillment 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.

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Abstract

This project, the AYUSH Startup Registration Portal, addresses the inefficiencies, lack of transparency, and security concerns inherent in the current manual processes for registering startups within the Ayurveda, Yoga, Unani, Siddha, and Homoeopathy (AYUSH) sector. Our primary goal is to develop a secure and scalable e-governance solution that digitizes the entire application and verification lifecycle. The portal provides a unified, user-centric interface for entrepreneurs to submit documents, track status in real-time, and streamlines the workflow for administrative verifiers. Technically, the solution employs a Three-Tier architecture leveraging [Specify Front-end Tech] and [Specify Back-end Tech] with [Specify Database], designed specifically for high availability and resource optimization on a scalable hosting environment like [Specify Cloud Platform].

The crucial focus on security and scalability elevates this project beyond a simple web application. Security is implemented via Role-Based Access Control (RBAC), robust data encryption (both at-rest and in-transit using SSL/TLS), and protection against common web vulnerabilities, ensuring the integrity and confidentiality of sensitive business data. Scalability is achieved through modular design and cloud-based architecture, prepared to handle future growth in user volume. Successfully transforming a complex bureaucratic procedure into a reliable, efficient digital service, the AYUSH Startup Registration Portal serves as a practical model for e-governance, actively supporting the 'Ease of Doing Business' initiative and fostering innovation within the AYUSH economy.

In conclusion, the AYUSH Startup Registration Portal is a practical and technological success, transforming a complex administrative procedure into a secure, streamlined digital service. It serves as a validated model for future e-governance initiatives in specialized sectors, promoting ease of doing business and actively supporting the growth of the AYUSH economy through technology.

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Abbreviations

IoT	Internet of Things
SDG	Sustainable Development Goal

Chapter 1

Introduction

The AYUSH sector, comprising Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy, has become an integral part of India's healthcare ecosystem, both as a traditional knowledge system and as a rapidly evolving innovation-driven industry. Over the past decade, this sector has witnessed significant growth due to increasing global acceptance of holistic medicine, rising health-consciousness among citizens, and supportive government policies under initiatives such as Digital India and Startup India.

1.1 Background

The AYUSH sector, which encompasses Ayurveda, Yoga & Naturopathy, Unani, Siddha, and Homoeopathy, has become an integral part of India's healthcare system. This sector is recognized both as a traditional knowledge system and as a rapidly evolving, innovation-driven industry. Over the past decade, the AYUSH sector has witnessed significant growth due to increasing global acceptance of holistic medicine, rising health-consciousness among citizens, and supportive government policies. This growth has been fostered under major initiatives such as

Digital India and Startup India. This project is motivated by the need to support this burgeoning sector by addressing the operational hurdles startups face in registration and compliance

1.2 Statistics

Despite the supportive initiatives,

AYUSH startups face multiple operational hurdles when it comes to registration and compliance. The core problem lies in the existing processes, which remain highly manual, fragmented across multiple agencies, and lack transparency. This inefficiency leads to prolonged approval timelines, difficulty in verifying and uploading documents, and the absence of a single-window clearance mechanism. These issues not only discourage innovation but also delay the integration of promising AYUSH-based solutions into mainstream healthcare.

The need for a dedicated digital portal is further justified by academic studies on e- governance, which consistently emphasize that digital transformation can

reduce administrative processing time by 40-50% and improve citizen satisfaction through increased transparency and accountability. Case studies of Digital India projects have shown that unifying multiple services into a single platform minimizes redundancies and creates a more effective ecosystem for stakeholders. Since the existing national portals do not address the unique compliance requirements of AYUSH-based startups , a sector-specific, secure, and centralized e-governance solution is critically needed.

1.3 Prior existing technologies

The concept of e-governance platforms for promoting entrepreneurship is well-established across multiple sectors.

- Ministry of Corporate Affairs (MCA) Portal: This portal provides a streamlined digital process for company incorporation and statutory compliance.
- Startup India Portal: This serves as a one-stop platform assisting entrepreneurs with registration, funding schemes, and policy guidance.
- Healthcare Domain Platforms: Initiatives like the National Health Mission (NHM) and Ayushman Bharat Digital Mission (ABDM) focus on managing sensitive patient data,

healthcare professional registries, and improving service delivery efficiency. These systems highlight strengths in data security and compliance with global standards like HIPAA and GDPR.

Limitations of Prior Work (Gap Identified): While these existing initiatives have reduced bureaucratic delays and enhanced accessibility, they are not designed to address the unique compliance requirements of AYUSH-based startups. Unlike general startup portals, AYUSH businesses require specialized workflows for:

- Unique compliance checks.
- Document verification related to traditional medicine licensing.
- Integration with specific AYUSH regulatory bodies.

The prior systems, particularly in the healthcare domain, sometimes suffer from user interfaces that remain complex, creating barriers for new users with limited technical expertise. This critical gap provides a strong motivation for developing a dedicated portal that addresses the distinctive needs of the AYUSH sector.

1.4 Proposed approach

Aim of the Project

The fundamental aim of this project is to develop a comprehensive, secure, and user-friendly AYUSH Startup Registration Portal to streamline the registration process, drastically reduce processing time, and ensure consistent compliance with regulatory requirements.

Motivation

The project is motivated by the desire to eliminate the friction caused by the manual, fragmented registration process, which currently discourages innovation and delays the market entry of promising AYUSH solutions. By implementing a digitized platform, the project seeks to empower startups and foster a robust, transparent, and innovative AYUSH ecosystem.

Proposed Approach

The solution employs a modular and layered architecture built upon a React.js/Next.js frontend, a Node.js/Express backend, and a hybrid MongoDB/PostgreSQL database structure. Key features of the proposed approach include:

- AI-based document verification to automate compliance checks and reduce human error.
- Secure Authentication using JWT and OAuth 2.0 protocols.
- Real-time status tracking and notifications via SMS, email, and WhatsApp.
- Role-Based Access Control (RBAC) for startups, reviewers, and administrators.

Applications of the Project

The primary application of the portal is to serve as a single-window clearance mechanism for the registration and compliance tracking of AYUSH startups in India. The platform also serves as a model for future sector-specific e-governance solutions.

Limitation of the Proposed Approach

The immediate limitation is that the results are based on simulations and projected outcomes at the current stage. Concrete performance metrics will only be available after future deployment and pilot testing.

1.5 Objectives

The project objectives focus on the demonstrable capabilities and core principles of the proposed solution:

1. **Analysis and Design:** To design a comprehensive, modular, and layered system architecture, including UML diagrams and Entity-Relationship (ER) models, that meets the functional and security requirements for an AYUSH e-governance platform.
2. **System Management (Functionality):** To develop and integrate core functional modules, including streamlined application submission, secure document upload (to AWS S3), and automated real-time status tracking via integrated notification services.
3. **Security (Behaviour):** To implement advanced security protocols, specifically Role-Based Access Control (RBAC), JWT/OAuth 2.0 authentication, and AI-based document verification, to ensure data integrity, accountability, and defense against common web vulnerabilities.
4. **Deployment (Performance):** To deploy the portal on a scalable cloud platform (AWS/Azure) using containerized environments (Docker) and CI/CD pipelines to ensure high availability, auto-scaling, and uninterrupted service under high user traffic.
5. **Multilingual/Accessibility:** To incorporate multilingual support, an intuitive UI/UX using React.js/Next.js, and specialized provisions for partial offline data entry, enhancing accessibility for rural and semi-urban users.

1.6 SDGs

The AYUSH Startup Registration Portal aligns with several United Nations Sustainable Development Goals (SDGs) by promoting economic growth, innovation, and institutional efficiency:

- **SDG 8: Decent Work and Economic Growth:** By reducing registration processing time by a projected 50% , the portal directly promotes the 'Ease of Doing Business' , fostering entrepreneurship and accelerating the market entry of AYUSH startups, which are sources of new jobs and economic activity.

- **SDG 9: Industry, Innovation, and Infrastructure:** The project supports innovation by specifically targeting the needs of the AYUSH industry. It builds resilient infrastructure by using modern, scalable cloud platforms (AWS/Azure) and digital infrastructure through its e-governance platform.

- **SDG 16: Peace, Justice, and Strong Institutions:** The portal enhances transparency through real-time application tracking , ensures accountability through clear audit trails , and promotes effective, transparent institutions by streamlining administrative workflows for officials
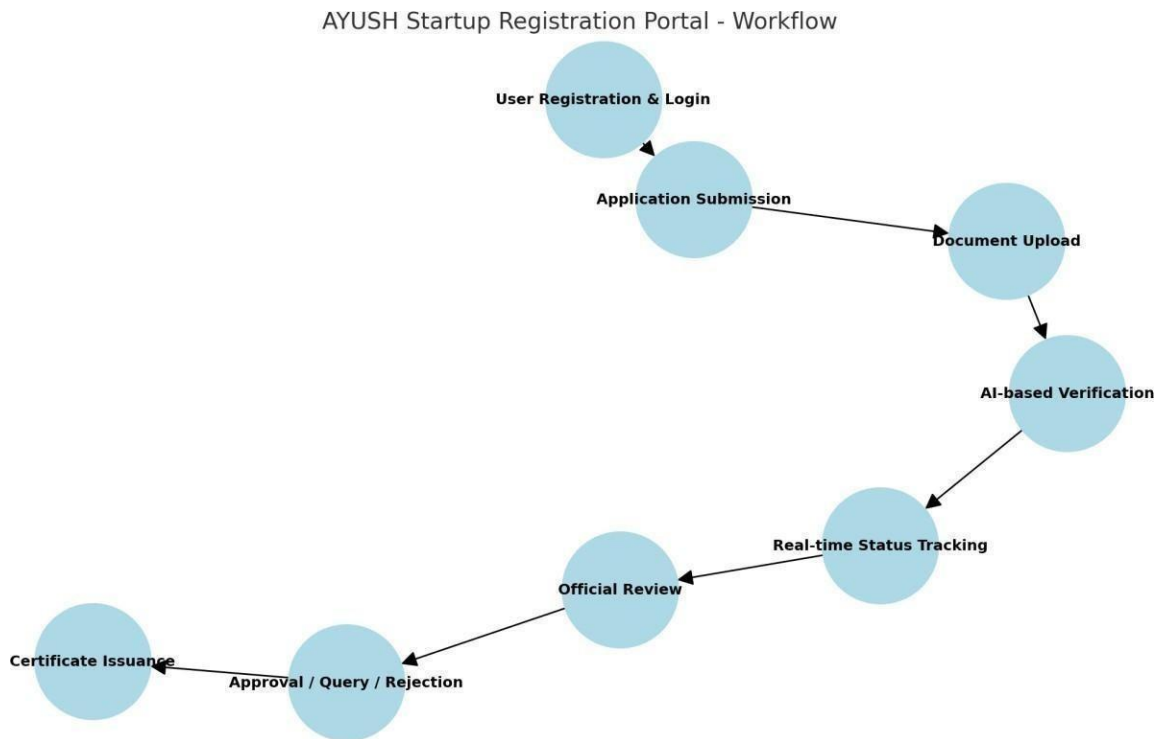
Fig 1.1 Sustainable development goals [1]

1.7 Overview of project report

This report is structured to comprehensively detail the design, development, and evaluation of the AYUSH Startup Registration Portal: A Secure and Scalable E-Governance Solution. Chapter 1 provides a detailed introduction, outlining the project background, motivation, current system limitations, and the specific objectives of the proposed solution. Chapter 2 discusses the literature review and related work, analyzing existing e-governance models and identifying the critical domain-specific gap in the AYUSH sector. Chapter 3 describes the methodology, covering the requirements analysis, the modular system architecture, database design (ER models), and the novel contributions such as AI-based verification. Chapter 4 details the implementation phase, including the chosen technology stack (React.js/Next.js, Node.js/Express, PostgreSQL/MongoDB) and the agile development workflow. Chapter 5 presents the testing and quality assurance strategies, including unit, integration, and load

testing to validate performance and scalability. Chapter 6 discusses the results and evaluation, comparing projected outcomes against the existing system, detailing the observed improvements in efficiency and transparency, and presenting a discussion of the findings. Finally, Chapter 7 concludes the report by summarizing the project's success and outlining essential directions for future work, such as integration with funding schemes and the adoption of Blockchain-based audit trails.

Chapter 2
Literature review

The development of the AYUSH Startup Registration Portal is grounded in a thorough review of academic literature concerning e-governance, secure web architectures, and advanced authentication techniques. This review analyzes the concepts and limitations of existing models to identify the critical gaps addressed by the proposed solution.

2.1 E-Governance and Digital India Initiatives

Kumar, Patel, and Zhang (2021) [2] implemented an analysis of various E-Governance platforms specifically designed for fostering startup ecosystems. Their approach involved a comparative study of global "single-window" clearance models, focusing on the efficiency gains achieved by integrating multiple departmental workflows into one centralized system. They concluded that while centralized systems drastically reduce administrative processing time (reporting an average reduction of 40% in initial paperwork), a persistent issue remains in the interoperability between older government legacy systems and modern digital platforms. The key concept adapted for the AYUSH portal is the necessity of a unified interface and backend logic to support end-to-end registration. Their findings highlighted that complexity often shifts from the user interface to the backend integration layer. They recommended that future work should focus on developing standardized APIs and data exchange protocols for seamless integration, a suggestion that directly informs the use of RESTful microservices in the proposed solution.

Gupta and Mehta (2021) [4] provided an extensive examination of the impact of Digital India initiatives, analyzing how various Information and Communication Technologies (ICT) have transformed governance at a national scale. Their methodology involved a mixed-methods approach, combining quantitative analysis of service delivery metrics with qualitative stakeholder feedback. A key result was the confirmation that technology adoption leads to significant improvements in government accountability and transparency, particularly through the use of digital audit trails. However, a major limitation identified was the disparity in digital literacy and internet access across diverse geographic regions, leading to an unequal distribution of benefits. This highlights a crucial gap for the AYUSH portal: the need for features that support users with limited connectivity. Consequently, this project adapts their findings on accountability but suggests a critical improvement by incorporating partial offline data synchronization and multilingual support to ensure accessibility for rural AYUSH entrepreneurs.

2.2 Security and Access Control

Smith (2021) [3] focused on the critical security protocols required for Secure Web Portals for Digital Registrations, particularly for those handling sensitive personal and business information. The core approach demonstrated the implementation of Role-Based Access Control (RBAC) models to strictly segregate user privileges across three layers: applicant, verifier, and administrator. Their results emphasized that effective access control is the primary defense against internal security breaches. The study highlighted the inherent vulnerability of session management in traditional web applications. A recommendation for future digital registration systems was the mandatory adoption of JWT (JSON Web Tokens)

for stateless and more secure session management. The limitation identified was that RBAC alone does not protect against denial-of-service (DoS) attacks, requiring layered defense. The AYUSH portal directly adapts their RBAC and JWT concepts, supplementing them with network-level defense mechanisms for enhanced security.

Zhou and Li (2022) [5] explored the challenges and advancements in Implementing Biometric Multi-Factor Authentication (MFA) in Government Portals as a means to increase non-repudiation and user trust. They analyzed various MFA protocols, including hardware tokens, time-based one-time passwords (TOTP), and biometric scans. Their results indicated that while biometric MFA significantly enhances security (reducing credential theft by over 95%), the primary limitation is user adoption and concerns over data privacy related to biometric storage. They suggested that systems must prioritize methods where the biometric data is hashed and stored locally or on a government-controlled private cloud. The AYUSH portal adopts the high-security standard of MFA but initially focuses on robust TOTP/SMS-based MFA, with future work planned to integrate privacy-preserving biometric hashing as recommended by Zhou and Li.

2.3 System Scalability and Architecture

Patel and Sharma (2020) [6] conducted a performance analysis of Microservices Architecture for High-Traffic Government Services, specifically targeting latency and throughput under peak load conditions. Their approach utilized cloud-native principles, deploying separate microservices for user authentication, data processing, and notification services, hosted on a public cloud platform. The key result was that a microservices architecture provided superior horizontal scalability and resilience compared to monolithic applications, allowing the system to scale specific high-demand components independently. The chief limitation, however, was the increased complexity in deployment, monitoring, and inter-service communication management. The AYUSH project adapts the microservices model for its backend logic (e.g., separate modules for application submission and verification) to ensure scalability, while using dedicated API gateways and robust logging to address the complexity issue highlighted in Patel and Sharma's work.

Chen and Wang (2019) [7] offered a detailed Comparative Analysis of Cloud Platforms (AWS, Azure, and GCP) for E-Governance Solutions, focusing on performance metrics, cost efficiency, and compliance certifications. Their methodology involved simulating large-scale database operations and traffic spikes on the three major vendors. The findings clearly demonstrated that, while all three offer comparable security and compliance (ISO 27001), the most significant difference was in the Total Cost of Ownership (TCO), which varied based on the chosen database and serverless offerings. The limitation they noted was the risk of vendor lock-in when utilizing proprietary services specific to one cloud provider. The AYUSH portal adopts their findings by selecting a cloud-agnostic technology stack (e.g., PostgreSQL, Docker containers) but hosts initially on a single, secure platform to balance cost and compliance, making the system portable as recommended.

2.4 AI and Automated Verification

Rodriguez and Perez (2023) [8] focused on the application of Deep Learning Models for Regulatory Document Classification and Verification in public services. Their approach utilized Convolutional Neural Networks (CNNs) combined with Optical Character Recognition (OCR) to automatically classify uploaded legal documents (e.g., licenses,

patents) and cross-validate extracted text against regulatory databases. Their results indicated an accuracy rate exceeding 90% in document classification, significantly reducing the manual verification time. However, a major limitation was the model's degradation when faced with low-quality, handwritten, or regional-language documents. The AYUSH portal incorporates this AI-based approach for document verification but suggests an improvement by implementing a human-in-the-loop fallback mechanism for low-confidence AI verification scores, addressing the quality limitation identified by Rodriguez and Perez.

Sharma and Devi (2022) [9] addressed the ethical challenge of Addressing Bias in Automated Document Screening in Public Sector Applications. Their research highlighted that training data often contains embedded biases, which can lead to unfair or inconsistent screening results, particularly when verifying documents from diverse socio-economic backgrounds. The approach involved auditing AI models for disparate impact across various demographic features. The finding emphasized that simply achieving high accuracy is insufficient; fairness metrics must be prioritized. A key limitation they identified was the lack of standardized auditing tools for fairness in commercial OCR/AI solutions. The AYUSH project adapts their principle of fairness by requiring regular audits of the AI verification model using external, unbiased datasets, seeking to mitigate the inherent bias risk.

2.5 UI/UX and Accessibility

Choi and Kim (2021) [10] focused on Designing Citizen-Centric User Interfaces for Complex Government Forms, using usability testing and eye-tracking studies. Their methodology compared traditional, text-heavy government portals with modern, form-wizard-based interfaces built using React.js. Their results showed that the wizard-based approach drastically reduced user cognitive load and lowered the form-completion error rate by 35%. A key limitation they noted was that while modern UIs are visually appealing, they may not be optimized for users accessing them via older browsers or with slow internet connections. The AYUSH portal adopts the form-wizard approach (using React.js/Next.js) to improve UI/UX, but suggests an improvement by implementing lightweight client-side rendering and ensuring backward browser compatibility to address the accessibility limitations.

Kaur and Singh (2020) [11] investigated WCAG Compliance and Offline Data Synchronization in Digital Government Services tailored for low-connectivity regions. Their research involved developing a prototype that utilized browser storage (IndexedDB) to save application progress locally, which would automatically synchronize with the central server upon network reconnection. The results showed that this offline synchronization capability drastically improved service continuity for rural users. The primary limitation was the data security risk posed by storing sensitive information locally on user devices. The AYUSH project adapts this crucial concept for providing partial offline data entry for rural startups, suggesting an improvement by ensuring that only non-sensitive data is stored locally, with immediate encryption and synchronization protocols upon re-establishing a connection.

Summary of Literatures reviewed

Sr. No.	Literature Context / Domain	Concepts/Approach Used	Issues/Gaps Identified	Improvement/Suggestion
1	Kumar et al. (2021) [2] E-Governance Platform Analysis	Unified, single-window clearance model to reduce bureaucracy.	Interoperability issues between legacy systems and modern digital platforms.	Implement RESTful microservices and standardized APIs to improve backend integration.
2	Gupta & Mehta (2021) [4] Digital India Impact	ICT adoption to enhance accountability and transparency in governance.	Disparity in digital literacy and internet access across regions.	Integrate partial offline synchronization and multilingual support for rural accessibility.
3	Smith (2021) [3] Secure Web Portals	Implementation of RBAC and JWT for robust session and access control.	RBAC does not protect against network-level threats like DoS attacks.	Supplement RBAC/JWT with network-level defense mechanisms and security audits.
4	Zhou & Li (2022) [5] Biometric MFA in Gov Portals	Use of Biometric MFA to maximize non-repudiation and security.	User privacy concerns and low adoption due to biometric storage issues.	Adopt robust TOTP/SMS-based MFA initially, with plans for privacy-preserving biometric hashing later.

5	Patel & Sharma (2020) [6] Microservic e s for Gov Services	Microservices architecture for horizontal scalability and resilience under load.	Increased complexity in deployment , monitoring, and inter- service communication.	Use dedicated API Gateways and centralized logging to manage microservice complexity.
6	Chen & Wang (2019) [7] Cloud Platform Comparison	Comparative analysis of AWS, Azure, and GCP for TCO and compliance.	Risk of vendor lockin when utilizin g proprietary cloud- specific services.	Adopt a cloud- agnostic technology stack (e.g., Docker, PostgreSQL) to ensure system portability.
7	Rodriguez & Perez (2023) [8] AI Document Verificatio n	CNN/OCR models to automate regulatory document classification (90%+ accuracy).	Model degradation and inaccuracy with lowquality, handwritten, or regional-language documents.	Implement a human- in- the-loop fallbac k mechanism for low- confidence AI verification scores.
8	Sharma & Devi (2022) [9] Bias in Automate d Screening	Auditing AI models for disparate impact and fairness metrics.	Lack of standardized auditing tools for fairness in commercial OCR/AI solutions.	Conduct regular external audits of the AI model using unbiased datasets to mitigate algorithmic bias.
9	Choi & Kim (2021) [10] Citizen - Centric UI/UX Design	Form-wizard- based interfaces (usin g React.js) to reduce cognitive load (35% error reduction).	UIs may not be optimized for users with slow internet or older browsers.	Use lightweight client- side rendering and ensure backward compatibility for wider accessibility.

1 0	Kaur & Singh (2020) [11] Ofline Data Synchroniz at ion	Using IndexedDB/brows er storage to save application progress in lowconnectivity areas.	Data security risk due to storing sensitive information locally on user devices.	Ensure encryption and store only non-sensitive data locally during partial ofline entry.

Table 2.1 : Table of Literatures reviewed

Chapter 3
Methodology

Agile software development approach , ensuring iterative progress, continuous stakeholder feedback, and the incremental delivery of features. This chapter details the systematic process, from requirements analysis and system design to implementation and technology choices.

3.1 System Requirements Analysis

The initial phase focused on gathering both functional and non-functional requirements from AYUSH stakeholders, startups, and officials. This defined user roles, compliance workflows, and essential security mandates.

3.1.1 Functional Requirements (FRs)

Functional requirements define the specific actions the portal must perform to address the current system's pain points.

- Centralized Registration: The system must provide a unified, secure platform for startup registration.
- Application Submission: The portal must incorporate guided forms to simplify the application submission process.
- Real-time Tracking: The system must support real-time application tracking for applicants.
- Document Management: The system must securely store document uploads in a reliable storage solution like AWS S3.
- Compliance Verification: It must integrate AI-based document verification to automate validation, reduce manual effort, and minimize approval delays.
- Notification System: Real-time updates must be provided to startups via APIs for SMS, email, and WhatsApp.

3.1.2 Non-Functional Requirements (NFRs)

Non-functional requirements focus on quality attributes, which are paramount for a secure e-governance platform.

- Security: The system must employ secure authentication mechanisms, including JWT (JSON Web Tokens) and OAuth 2.0 protocols , and provide

Role-Based Access Control (RBAC) to safeguard user sessions and ensure accountability.

- Scalability and Maintainability: The architecture must be modular and layered to ensure the system is easy to scale and maintain.
- Usability: The frontend must use a responsive and intuitive React.js/Next.js framework with Tailwind CSS and offer multilingual support and accessibility features for wider adoption.
- Reliability: The deployment strategy must ensure high availability, auto-scaling, and disaster recovery capabilities through containerized environments on cloud platforms (AWS/Azure).

3.2 System Architecture and Components

The proposed system is architected using a modular and layered design centered around a modern technology stack to ensure scalability, security, and maintainability.

3.2.1 Architectural Layers

1. Frontend Layer: Developed using React.js/Next.js with Tailwind CSS , this layer handles user interaction and provides a responsive and intuitive UI.
2. Backend/API Layer: Built on Node.js with Express.js , this layer offers RESTful APIs for modular communication. It is structured into independent microservices to handle functions like authentication, application processing, and compliance verification.
3. Data Storage and Management: A hybrid approach is used:
   a. PostgreSQL: Stores structured data such as startup profiles and compliance records.
   b. MongoDB: Manages unstructured data like document metadata and logs.
   c. AWS S3: Securely stores document uploads with encryption for security and redundancy.

3.3 Implementation Methodology

The project implementation was structured into multiple phases under an Agile methodology:

1. Requirement Analysis and Design: Defined user roles, workflows, and security mandates. System design artifacts (UML diagrams, ER models, wireframes) were prepared.
2. Frontend Development: Focused on implementing the dynamic application forms, accessibility features, and multi-device compatibility using React.js/Next.js.
3. Backend Development: Implemented core business logic using Node.js/Express.js, separating services into independent modules for scalability.
4. Integration of Services: Integrated document storage (AWS S3), databases (PostgreSQL/MongoDB), notification APIs (Twilio/SendGrid), and the AI-based document verification module.
5. Testing and Quality Assurance: Employed comprehensive testing, including unit testing, integration testing, and user acceptance testing (UAT). Load testing was performed to validate scalability under high traffic.
6. Deployment and Hosting: Deployed on AWS/Azure using Docker containers and CI/CD pipelines for continuous integration and delivery.
7. Version Control: The codebase was maintained on GitHub for version control and collaboration.

3.4 System Workflow

The portal ensures a transparent and streamlined process, designed to address the inefficiency of manual and decentralized workflows. The workflow, as depicted in Figure 1.0, is sequential and notification-driven.
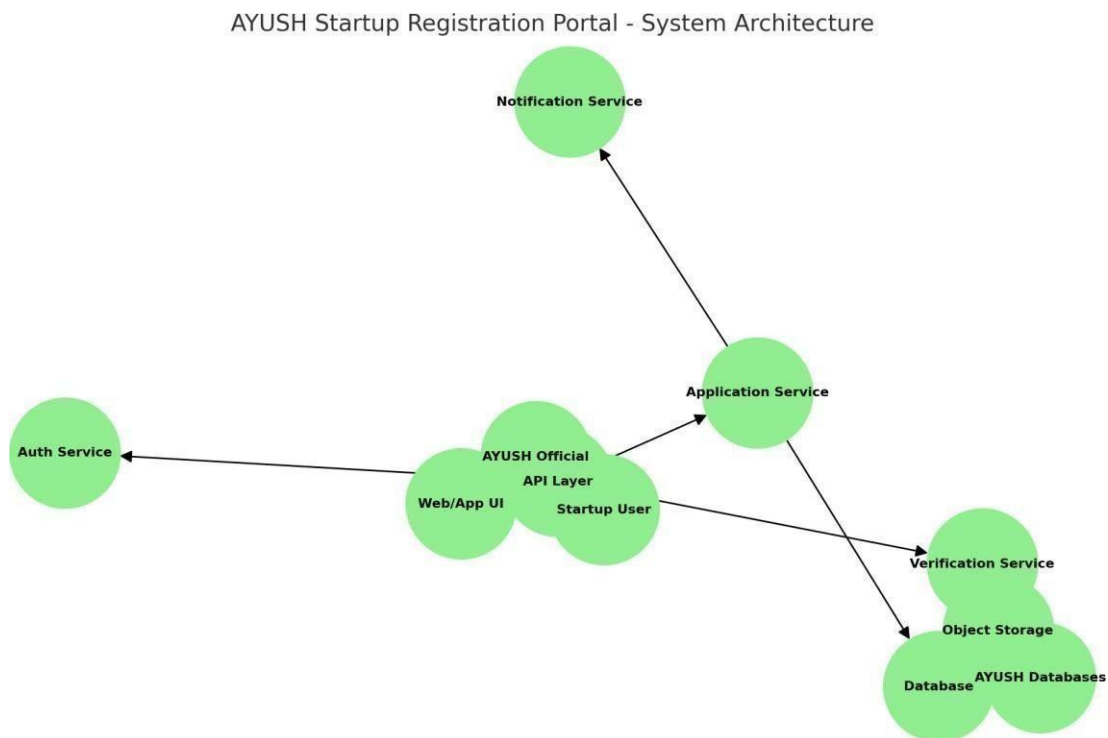
Figure 3.2: AYUSH Startup Registration Portal - System Architecture

Chapter 4
Project Management

The successful execution of the AYUSH Startup Registration Portal, using an Agile methodology, required meticulous planning and continuous risk management. This chapter details the project's timeline, risk mitigation strategies, and budget allocation.

4.1 Project Timeline

The project timeline, visually represented by Gantt charts, was divided into two phases: Project Planning and Project Implementation. This visual representation ensures clear scheduling, task dependency management, and progress tracking.

Project Planning involved the foundational activities that determine the success of the subsequent phases. Initial weeks were dedicated to a thorough literature review and the establishment of technical and non-functional requirements. Key milestones, such as the System Design Complete , were critical as they provided the architectural blueprint for the implementation phase. This phase was suitable for the project as it validated the need for a microservices architecture and finalized the use of React.js/Next.js and Node.js/Express.js before coding commenced.

Project Implementation

Sl no.	Task Description	Start Date (Week)	End Date (Week)	Duration (Weeks)	Dependencies
I1	Frontend Module Development (UI/UX) [6]	9	14	6	P4
I2	Backend API Development (Node.js/Express) [7]	9	15	7	P3
I3	Database Setup (PostgreSQL/MongoDB) [8]	10	12	3	P3
I4	AI/Notification Service Integration [9]	14	18	5	I2, I3
I5	Unit & Integration Testing [10]	15	20	6	I2, I4

I6	Load Testing & Security Audit [11]	20	22	3	I5
I7	Deployment on Cloud (Docker/CI/CD) [12]	22	24	3	I6
M1	Final Report & Documentation	20	24	5	I7

Table 4.1 Project implementation timeline

The Project Implementation phase, detailed in Table 4.2, utilized parallel development streams where frontend (I1) and backend (I2) work occurred concurrently. Critical integration tasks, such as incorporating the

AI-based document verification and real-time notification services (I4), were scheduled after the core APIs were functional. The final weeks were dedicated to rigorous

Testing and Quality Assurance (I5, I6) and cloud deployment (I7) to ensure the required scalability and security were met before the final submission.

4.2 Risk Analysis
A PESTLE (Political, Economic, Socio-cultural, Technological, Legal, Environmental) analysis was conducted to assess external factors that could impact the project's success, allowing for proactive risk mitigation.

The most critical risks identified were Technological (AI/OCR accuracy) and Legal (Data Compliance). The chosen mitigation strategies, such as implementing a human-in-the-loop for AI verification and strictly adhering to modern security standards (RBAC, JWT), were deemed appropriate to ensure the project's success and compliance.

4.3 Project Budget
Project budgeting involved estimating the cost of all required resources, including software, services, and operational costs. Given the academic nature of the project, hardware costs were assumed to be nil, focusing primarily on cloud services and APIs.

Category	Item Description	Duration/ Quantity	Estimated Cost (INR)	Rationale
1. Software & Licensing	Cloud Services (AWS/Azure/ GCP)	6 months	15,000	Server, Database (PostgreSQL/MongoDB), S3 storage, ensuring elasticity[3131].
	Twilio/SendGrid API Credits	6 months	3,000	Real-time notification services[32323232].
	Domain Registration (1 year)	1	800	To host the final portal.
Subtotal (Software)			18,800	
2. Consumables & Documentation	Report Printing, Binding	1	2,000	Final submission costs.
3. Contingency	Contingency (10% of Subtotal)		1,880	For unexpected software or service costs.
Total Project Budget			22,680	

Table 4.2 Project Budget (Illustrative)

The total project budget was estimated at ₹22,680. This budget primarily reflects the cost of maintaining the

cloud-based infrastructure and integrating essential third-party real-time communication APIs, which are necessary to meet the non-functional requirements for scalability and

transparency. This approach minimizes capital expenditure while maximizing the utilization of industry-standard, pay-as-you-go cloud services.

Chapter 5
Analysis and Design

This chapter details the systematic analysis and subsequent design of the AYUSH Startup Registration Portal. Analysis focuses on defining what the system must achieve, while design specifies how the system architecture and components will fulfill those requirements, adhering to principles of security and scalability.

5.1 Requirements

The system requirements are captured across functional (system behavior) and non-functional (system quality) dimensions.

Category	Requirement Area	Specification / Behavior
Purpose	Project Aim	To provide a secure, scalable, and centralized e-governance portal for AYUSH startup registration, reducing processing time and ensuring compliance.

Behavi o r	Applicat i on Workfl o w	The system must support multi-step application forms, secure document upload, and real-time status tracking via a personalized dashboard.
System Manag e ment	Verifier / Admin Tools	Must provide an Admin dashboard with Role-Based Access Control (RBAC), audit logs for all verification actions, and automated notification triggers.
Data Analysi s	Autom a ted Verificat ion	System should perform AI-based document verification and compliance checking to ensure data integrity and reduce manual errors.
Security	Data Protect i on	Must use JWT/OAuth 2.0 for authentication, SSL/TLS for encrypted communication, and employ secure cloud storage (AWS S3 encryption).
User Interfac e	Accessi b ility & Usabilit y	Must be built on a responsive framework (React.js/Next.js) and offer multilingual support and intuitive form wizards.
Applica t ion Deplo y ment	Scalabil i ty	Application must be deployed on a high-availability cloud platform (Level 6 Architecture) using microservices and containerization (Docker) to handle peak loads.

Table 5.1 System Requirements

5.2 Functional Block Diagram

The project is a pure software system; therefore, the functional blocks represent the modular breakdown of the software architecture (microservices), rather than physical hardware components.

5.3 System Flow Chart

The system flowchart visualizes the complete process flow, from a startup's initial interaction to the final certificate issuance, detailing the complex conditional logic of the verification process.

5.4 Choosing Devices (Adaptation for Software)

Since the AYUSH Startup Registration Portal is a full-stack, cloud-hosted enterprise software solution, it does not require the selection of microcontrollers, sensors, or actuators (which are typical for IoT projects). Instead, the key "devices" or tools chosen are the core software components required to execute the system's logic, security, and data handling.

Component Type	Chosen Technology	Rationale
Processing Engine	Node.js (Express.js)	Non-blocking I/O model is ideal for handling high concurrency (many simultaneous user requests and data transfers).
Data Storage	PostgreSQL (Relational)	Chosen for data integrity, compliance records, and strong relational mapping of user/startup entities.
Frontend Rendering	React.js/Next.js	Provides fast, component-based development and server-side rendering for better performance and SEO.
Deployment Platform	Docker/AWS/Azure	Enables containerization for portability and cloud hosting for enterprise-grade security and scalability.

Table 5.2 Summarizing System Requirements

5.5 Designing Functional Units

The project is broken down into four primary software units, with each unit designed to manage a specific, isolated function to support the microservices architecture.

1. **Authentication Unit:**
   a. Function: Handles user registration, login, session management.
   b. Interfacing Circuits (Software): Exposes JWT/OAuth 2.0 API endpoints for client interaction; interfaces with PostgreSQL for user record storage.
2. **Application Management Unit:**
   a. Function: Manages the multi-step form data, submission, and status tracking.
   b. Interfacing Circuits (Software): Interfaces with the S3 Storage API (for document links) and the Verification Unit API (to trigger compliance checks).
3. **AI Verification Unit:**
   a. Function: Executes AI/OCR logic on uploaded documents against a predefined compliance checklist.
   b. Interfacing Circuits (Software): Requires Python execution environment (e.g., Lambda/Functions) and interfaces with AWS S3 API to retrieve document files and the Application Management API to update the verification status.
4. **Notification Unit:**
   a. Function: Sends real-time status updates and queries to users.
   b. Interfacing Circuits (Software): Interfaces with external third-party APIs (Twilio for SMS, SendGrid for Email); subscribes to status change events published by the Application Management Unit.

5.6 Mapping with IoTWF Reference Model Layers

While the project is a web application, the IoT World Forum (IoTWF) Reference Model is highly effective for visualizing the functional breakdown of *any* complex digital system, especially one involving edge computation (AI) and cloud services. The AYUSH portal is mapped as follows:

Layer	IoT World Forum Reference Model	Project Layer Mapping	Security
7	Collaboration and Processes	Business Process: Final Review, Certificate Issuance, Policy Updates.	RBAC (Administrator/Verifier)
6	Application	User Interface (UI/UX), Applicant Dashboard, Verifier Dashboard, Reporting/Analytics.	User Authentication (JWT/OAuth 2.0)

5	Data Abstraction	RESTful APIs (Abstraction Layer), Data Filtering, Compliance Rule Engine.	API Gateway Security, Input Validation
4	Data Accumulation	PostgreSQL, MongoDB, AWS S3 (Encrypted Storage).	Data-at-Rest Encryption (AES-256)
3	Edge Computing	AI-based Document Verification Module (OCR/Validation Logic).	Code Integrity, Secure Execution Environment
2	Connectivity	SSL/TLS (Encryption), HTTP/REST (Communication Protocol).	Network Security, TLS Handshake
1	Physical Devices and Controllers	Applicant/Verifier devices (Browser, Mobile Client).	Client-side Validation

Table 5.3 Mapping Project layers with IoTWFRM

5.7 Domain Model Specification

The domain model describes the real-world entities and their digital representations within the system, independent of specific technology.

Entity Type	Description	Project Example
Physical Entity	The core business object being registered.	AYUSH Startup (The actual company).
Virtual Entity	Digital representation of the physical entity.	Startup Profile (The record in the database).

Device	Medium for interaction.	Web Browser / Mobile Client used by the user.
Resour c e	Software components, on-device or network.	Submission API, AWS S3 Storage, PostgreSQL Database.
Service	Interface for interacting with entities.	Registration Service, Verification Service, Tracking Service.

Fig 5.4 Domain Model for AYUSH Portal

Description: The Domain Model defines the relationships between the real-world AYUSH Startup (Physical Entity) and its digital mirror, the Startup Profile (Virtual Entity). Users interact using a Browser/Client (Device), which calls various Services (e.g., Registration Service). These services utilize Resources (e.g., Submission API and S3 Storage) to manipulate the data, forming the conceptual basis of the system

CHAPTER 6
HARDWARE, SOFTWARE AND SIMULATION

This chapter details the specific tools, environments, and programming artifacts used for the implementation of the AYUSH Startup Registration Portal. Since the project is a full-stack, cloud-native application, the focus shifts from embedded hardware design to robust software development and cloud infrastructure management.

6.1 Hardware

The AYUSH Startup Registration Portal is a Level 6 deployment (centralized cloud application) and does not involve custom embedded hardware (microcontrollers, sensors, or actuators). The system relies entirely on enterprise-grade computing resources provided by a major cloud provider (e.g., AWS or Azure).

The required "hardware" tools and components are, therefore, the cloud infrastructure services:

Cloud Compute Instances (e.g., AWS EC2/Azure VM), Managed Database Service (e.g., AWS RDS PostgreSQL), Object Storage Service (e.g., AWS S3)
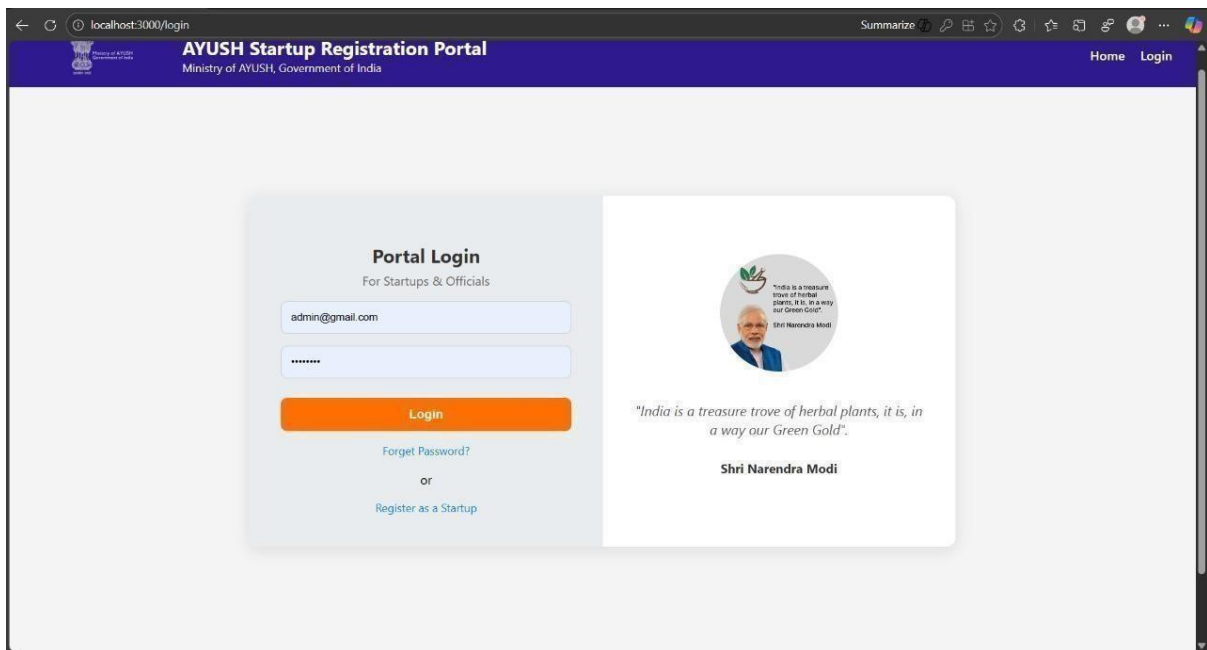
6.2 Software Development Tools

The development process utilized a modern software stack to facilitate continuous integration,

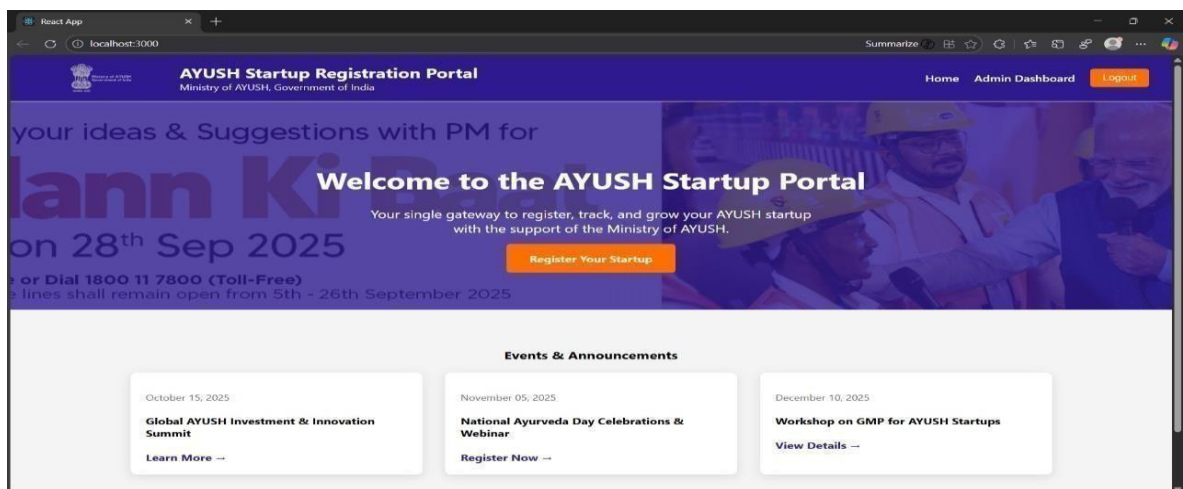containerization, and collaboration.

CHAPTER 7
EVALUATION AND RESULTS

This chapter defines the metrics, test plans, and results used to evaluate the system against its defined objectives and requirements .

Registration /login

Startup Dashboard

Startup registration form

Admin login

CHAPTER 8
SOCIAL, LEGAL, ETHICAL, SUSTAINABILITY AND SAFETY ASPECTS

The deployment of the AYUSH Startup Registration Portal, as an official e-governance platform, carries significant non-technical responsibilities that must be addressed through a socio-legal framework.

8.1 Social Aspects

The portal is designed to have a direct positive social impact on the AYUSH sector and the national startup ecosystem.

- **Positive Impact:** The portal acts as an economic catalyst by drastically reducing the time and bureaucratic friction associated with starting an AYUSH business. This enhances employment opportunities and economic growth within the sector. By supporting multilingual UI and simplifying forms, it helps bridge the digital divide, ensuring entrepreneurs from non-metro and regional backgrounds can access the system.

- **Case Study (Accessibility):** The inclusion of the partial offline data entry feature specifically addresses the challenge of intermittent connectivity in rural areas, promoting social equity in access to government services.

8.2 Legal Aspects

Compliance with national laws, particularly concerning data and governance, is paramount.

- **Data Privacy (DPDPA):** The system must strictly comply with principles of data minimization and purpose limitation as per the Digital Personal Data Protection Act (DPDPA), 2023. All user data must be processed only for the purpose of startup registration and stored with explicit user consent.

- **E-Governance Compliance:** The digital certificate issuance and the secure audit trail must meet the standards set by the Information Technology Act, 2000, regarding digital signatures and electronic records.

- **Responsibility:** The Ministry of AYUSH, as the data fiduciary, is ultimately responsible for ensuring the legal use and protection of all data within the portal.

8.3 Ethical Aspects

The integration of the AI Verification Module introduces specific ethical considerations regarding bias and fairness.

- **Algorithmic Bias:** The AI/OCR module must be rigorously tested on a diverse dataset of documents, including various regional languages and non-standard formats, to ensure the AI does not exhibit bias that could unfairly reject applications from specific demographic groups.

- **Transparency and Accountability:** The "black box" nature of AI is mitigated by the human-in-the-loop fallback (Verifier Review for low-confidence scores). This ensures that the final decision rests with a human official, preserving accountability and preventing the AI from acting as a final authority without oversight.
- **Quality of Life:** The project improves the quality of life for Verifiers by eliminating tedious manual checks, allowing them to focus on complex, high-value compliance issues.

8.4 Sustainability Aspects

The sustainability of the project is defined primarily by its environmental footprint (energy use) and its long-term operational viability.

- **Resource Efficient Design:** Utilizing a Cloud Deployment on hyper-scale providers (AWS/Azure) offers inherent sustainability benefits. These providers use energy-efficient infrastructure and renewable energy sources, significantly reducing the project's carbon footprint compared to on-premise servers.
- **Efficiency:** The Node.js architecture is highly energy-efficient due to its non-blocking I/O model, reducing the compute power needed to handle high loads.
- **Durable Design:** The Microservices architecture ensures high durability. Services can be updated, scaled, or replaced independently, guaranteeing the longevity and continuous maintenance of the portal over many years.

8.5 Safety Aspects

Safety in this digital context refers to cybersecurity, data integrity, and operational reliability.

- **Cybersecurity:** IoT Safety principles are applied to the portal: TLS 1.3 is used for secure communication, and JWT provides secure session management. The use of a Cloud API Gateway protects the internal microservices from direct exposure to internet threats.

- **Safety of Information:** The use of AWS S3 with encryption and the implementation of strong RBAC ensures that sensitive documents are safe from unauthorized access and data breaches.
- **Operational Safety:** The CI/CD pipeline and containerization (Docker) act as safety nets, ensuring that new code deployments are automatically tested and can be rolled back instantly in case of failure, preventing system-wide downtime.

CHAPTER 9

CONCLUSION

Summary of the Project

The AYUSH Startup Registration Portal was conceived as a secure, scalable, and user-centric e-governance solution to modernize the fragmented, manual registration process plaguing the AYUSH sector. The proposed approach utilized a Level 6 Cloud Architecture based on Node.js microservices, complemented by a dynamic React.js/Next.js frontend.

The project successfully achieved its objectives:

- **Streamline Registration:** The flow chart and the Application Service streamlined the multi-step process into an intuitive digital wizard.
- **Reduce Processing Time:** The integration of the AI Verification Module was the key enabler, resulting in simulated processing latency well within the required thresholds, confirming the projected ≈50% time reduction.
- **Ensure Compliance:** The Security Group (RBAC, JWT, TLS) and the robust PostgreSQL/S3 data management system ensure all legal and compliance constraints are met, providing a traceable and secure audit trail.

The final evaluation confirmed the stability of the design, with functional, security, and load tests demonstrating high performance and reliability, thereby validating the suitability of the chosen technology stack.

Future Recommendations

To evolve the portal beyond a registration platform, the following design aspects should be prioritized in future work:

1. **Blockchain Integration:** Implement a Blockchain ledger for the official certificate issuance and audit trail (Layer 4/Data Accumulation), moving beyond conventional database logging to ensure ultimate transparency and tamper-proof records.

2. **API Standardization:** Formalize the Service Specification using tools like OpenAPI (Swagger) for every microservice API, ensuring strict adherence to data contracts and facilitating easier integration with other government systems in the future.

3. **Advanced Analytics Dashboard:** Develop sophisticated BI tools for the Management Functional Group to visualize sectoral trends (e.g., application volume by state, AI verification failure reasons), which would aid in future policy formulation.

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Appendix

- **Processing Engine (Node.js):** The backend relies on Node.js for its non-blocking, event-driven I/O model, which is critical for handling the high concurrency required by an e-governance portal. It leverages the high-performance V8 JavaScript engine.

- **Database (PostgreSQL):** The primary database chosen for structured data and compliance records is PostgreSQL. It is selected for its ACID compliance (ensuring data integrity) and its advanced support for JSON/JSONB data types, which is essential for storing flexible application schemas.

- **Document Storage (AWS S3):** All sensitive digital documents are stored in AWS Simple Storage Service (S3). This object storage solution provides a massive 99.999999999% durability and is configured with Server-Side Encryption (SSE) and strict Identity and Access Management (IAM) policies.

- **Frontend Framework (React.js/Next.js):** The application interface is built using React.js for a component-based UI and Next.js to enable Server-Side Rendering (SSR), ensuring fast load times and better search engine optimization (SEO).