4. TECHNOLOGY USED

4.1 Technology Stack Overview

The Study in Woods platform uses a modern, scalable technology stack with clear separation between frontend, backend, database, and cloud services layers.

4.2 Frontend Technologies

Technology	Version	Purpose	Key Features
Next.js	15.5.6	React Framework	SSR, SSG, API Routes, Turbopack, Image Optimization
React	19.1.0	UI Library	Server Components, Suspense, Virtual DOM, Hooks
TypeScript	5.x	Type Safety	Static Typing, IntelliSense, Compile-time Errors
Tailwind CSS	4.0	Styling	Utility Classes, JIT Compiler, Dark Mode, Responsive
shadcn/ui	Latest	UI Components	Accessible, Customizable, Radix UI Primitives
TanStack Query	5.90.9	State Management	Caching, Auto-refetch, Optimistic Updates
Framer Motion	12.23.24	Animations	Declarative Animations, Gestures, Layout Transitions
React Hook Form	7.66.0	Form Management	Validation, Performance, Error Handling
Zod	4.1.12	Schema Validation	Type-safe Schemas, Runtime Validation
Axios	1.13.2	HTTP Client	Interceptors, Request Cancellation, Auto JSON

4.3 Backend Technologies

Library	Version	Purpose	Key Capabilities
Go	1.24.1	Programming Language	Goroutines, Channels, Fast Compilation, GC
Fiber	2.52.5	Web Framework	Fasthttp, Middleware, Routing, Context
GORM	1.31.0	ORM	Migrations, Associations, Hooks, Preloading
JWT	5.3.0	Authentication	Token Generation, RS256, Claims Validation
bcrypt	0.43.0	Password Hashing	Adaptive Cost, Automatic Salting
go-redis	9.16.0	Redis Client	Connection Pooling, Pipelining, Pub/Sub
AWS SDK	1.55.8	S3 Client	Multipart Upload, Pre-signed URLs, Retries
Validator	10.28.0	Input Validation	Struct Tags, Custom Validators, Error Messages
Cron	3.0.1	Job Scheduling	Cron Expressions, Job Chains, Error Handling

4.4 Database Technologies

Technology	Version	Type	Primary Use Cases
PostgreSQL	15.x	Relational Database	Permanent data storage, Complex queries, ACID transactions, JSONB support
Redis	7.x	In-Memory Cache	Session storage, Rate limiting, Temporary data, Pub/Sub

4.5 Cloud Services & Infrastructure

DigitalOcean provides the complete cloud infrastructure, selected for its simplicity, transparent pricing, and India-specific infrastructure (Bangalore BLR1 region).

Service	Provider	Purpose	Specifications
Droplets	DigitalOcean	Compute	4 vCPU, 8GB RAM, 100GB SSD, Ubuntu 22.04
Spaces	DigitalOcean	Object Storage	S3-compatible, CDN, BLR1 region, Private ACL
Load Balancer	DigitalOcean	Traffic Distribution	SSL termination, Health checks, WebSocket support
GradientAI	DigitalOcean AI	LLM Inference	Llama 3.3 70B, OpenAI-compatible API
Knowledge Bases	DigitalOcean AI	Vector Database	RAG, Embeddings, Document indexing

4.6 Development & Deployment Tools

Tool	Version	Purpose	Benefits
Docker	24.0+	Containerization	Consistency, Isolation, Easy deployment
Docker Compose	2.x	Multi-container orchestration	Local development, Service dependencies
Air	Latest	Live reload (Go)	Fast feedback, Incremental builds
Turbopack	Integrated	Frontend bundler	5x faster builds, HMR with state preservation
GitHub Actions	Latest	CI/CD	Automated testing, Continuous deployment
Git	2.x	Version control	Collaboration, History, Branching

4.7 System Architecture

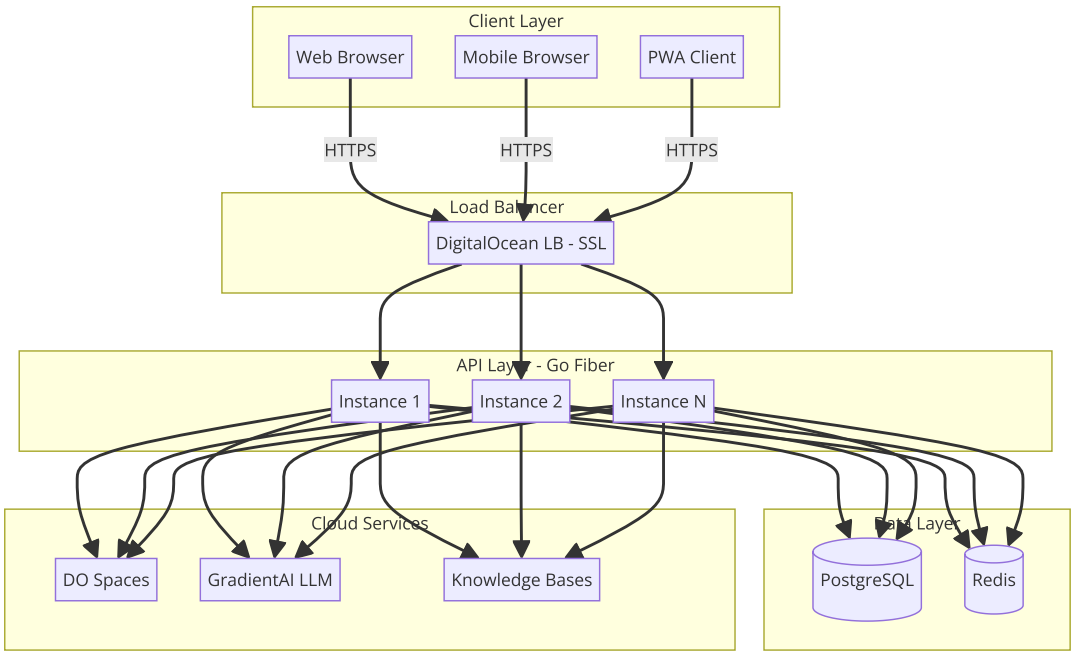

Figure 4.1: System Architecture Overview

4.8 Technology Selection Summary

Decision	Choice	Rationale
Backend Language	Go over Node.js/Python	3x more requests/sec than Node.js, single binary deployment, compile-time error checking
Database	PostgreSQL over MongoDB	Relational data model fits academic hierarchy, ACID guarantees, JSONB for flexibility
Frontend Framework	Next.js over CRA	SSR for SEO, 60% faster initial load, built-in routing and image optimization
Cloud Provider	DigitalOcean over AWS	Transparent pricing, Bangalore data center (15-30ms latency), integrated GradientAI