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COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE
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BACHELOR OF SCIENCE IN INFORMATION SYSTEMS
INDUSTRIAL PROJECT I

**BOOKNEST—AN ETHIOPIAN DIGITAL PLATFORM WITH MARKETPLACE,
READING TRACKER, AND SOCIAL FEATURES**

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List of Acronym

Acronym	Full Form
API	Application Programming Interface
BAA	Business Area Analysis
BaaS	Backend-as-a-Service
BR	Business Rule
CDN	Content Delivery Network
CI/CD	Continuous Integration/Continuous Deployment
CSS	Cascading Style Sheets
CSV	Comma-Separated Values
DMCA	Digital Millennium Copyright Act
DRM	Digital Rights Management
ENUM	Enumeration
ETB	Ethiopian Birr
FK	Foreign Key
GB	Gigabyte
GDPR	General Data Protection Regulation
HTTP	Hypertext Transfer Protocol
IDE	Integrated Development Environment
ISBN	International Standard Book Number

ISR	Incremental Static Regeneration
JSON	JavaScript Object Notation
LTS	Long Term Support
P2P	Person-to-Person
PDF	Portable Document Format
PIECES	Performance Information Economics Control Efficiency Service
PII	Personally Identifiable Information
PWA	Progressive Web Application
RAM	Random Access Memory
SDLC	Software Development Life Cycle
SEO	Search Engine Optimization
SLA	Service Level Agreement
SSD	Solid State Drive
UAT	User Acceptance Testing
UC	Use Case
UI	User Interface
UUID	Universally Unique Identifier
UX	User Experience
WBS	Work Breakdown Structure

Chapter one: Introduction

This chapter presents an overview of the project by outlining the problem statement, project objectives, which include both general and specific objectives., and the defined scope of the system. It also describes the project schedule, work breakdown structure (WBS), and major project activities to provide a clear understanding of how the project is planned and managed. In addition, a feasibility analysis is discussed, covering technical, schedule, operational, and economic feasibility to evaluate the practicality and viability of the proposed system.

Furthermore, the chapter explains the development methodology adopted for the project, highlighting the approach used throughout the system development lifecycle. It also presents the development tools and technologies applied in the project, including those used for front-end development, back-end development, database management, and deployment. The significance of the project and its beneficiaries are addressed, along with the project assumptions, risk assessment, phases, and deliverables, to establish a complete foundation for the successful execution of the project.

1.1 Overview

This project proposes the development of progressive web app(PWA) to serve as an integrated digital ecosystem for Ethiopian literature. The platform consolidates three core functionalities: a secure marketplace for digital books, an intelligent reading tracker, and a social community with real-time interaction. Developed with full bilingual support for Amharic and English, BookNest addresses the fragmented nature of book discovery, consumption, and discussion in the current Ethiopian digital landscape. By providing a unified, installable application that works across all devices, the project aims to create a centralized hub for readers, authors, and publishers.

1.2 Statement of the Problem

A problem statement defines a specific issue or condition that needs to be addressed or improved. It outlines the gap between the current situation and the desired outcome, helping to guide the development of effective solutions. In our project context, book lovers face

severe fragmentation in their reading journey that makes reading, sharing, discussing, and legally purchasing books frustrating, time-consuming, and often unsafe. These challenges are particularly acute in the Ethiopian context and affect readers, authors, and the literary community as follows:

I. Absence of a Unified Digital Platform:

Problem: Ethiopian readers are forced to use multiple disconnected tools for discovering, purchasing, reading, tracking progress, and discussing books, resulting in fragmented experiences, unsynchronized progress, scattered reviews, and abandoned reading goals.

Goal: Design a single, trusted digital platform that enables readers to discover, purchase, read, track progress, and discuss Ethiopian books in one centralized environment.

II. Ineffective and Unsafe Digital Commerce:

Problem: Legitimate digital access to Amharic and Ethiopian books is limited, forcing readers to rely on informal social media channels where payments are unregulated, files are often pirated or incomplete, and trust between buyers and sellers is low.

Goal: Provide a secure digital marketplace that supports legitimate book distribution, transparent pricing, reliable payment processing, and safe delivery of digital book files.

III. Automatic Reading Intelligence Does Not Exist Locally:

Problem: Ethiopian readers lack access to local systems that automatically record reading or listening activity, making it difficult to track pages read, session duration, reading streaks, and estimated completion times.

Goal: Implement an automated reading-tracking mechanism that records user activity and generates meaningful reading progress metrics.

IV. Weak and Scattered Literary Social Interaction

Problem: Literary discussions and reading communities are scattered across informal messaging platforms, limiting sustained engagement, organized discussions, and visibility of readers' and authors' activities.

Goal: Establish a dedicated digital reading community that enables users to follow authors, join genre-based groups, participate in discussions, and engage in real-time one-to-one and group conversations.

V. Limited Sales Channels for Authors and Small Publishers:

Problem: Independent authors and small publishers lack a simple, trusted digital channel to upload content, set prices, receive payments, and directly distribute digital books while engaging with their readership.

Goal: Create an accessible publishing interface that allows authors and publishers to manage digital content, conduct secure sales, and build direct relationships with readers.

In summary, the core problem is the absence of a trusted, Amharic-supported digital ecosystem in Ethiopia that integrates secure digital book distribution, automated reading-progress tracking, and structured literary social interaction within a single platform. This gap highlights the need for a unified system capable of supporting readers, authors, and publishers in a reliable and coordinated digital environment.

1.3 Objectives of the Project

1.3.1 General Objective

The general objective of the project is to design and develop a Progressive Web Application (PWA) that serves as a secure digital marketplace, an intelligent reading tracking system, and a real-time social reading community for Ethiopian literature with complete Amharic and English language support.

1.3.2 Specific Objective

The following procedures will be carried out to fulfill the general objectives outlined above:

- Analyze the current Ethiopian digital book ecosystem and identify the key problems faced by readers, authors, and publishers in discovery, purchase, reading tracking, and social interaction.
- Define and document the complete functional and non-functional requirements for the BookNest platform, establishing a clear specification for development.
- Perform object-oriented analysis, including use case modeling, conceptual class design, and dynamic modeling, producing a validated system design document.
- Design the system architecture, database schema, and user interface for the platform.
- Create a user interface prototype and design specification that validates usability, user flow, and bilingual (Amharic/English) support for all core user roles.
- Formulate a detailed project plan, including a phased work breakdown structure (WBS) and schedule for the 8-month timeline, transitioning from structured planning to adaptive development.
- Implement the complete BookNest system according to the finalized specifications, utilizing the defined technology stack.
- Test and evaluate the deployed system's overall success in meeting the project's objectives.

1.4 Feasibility study

A feasibility study is a short-term, relatively cheap study that informs the decision of whether or not to go ahead with a more detailed analysis. It is a focused study that should take place early in the requirements engineering (RE) process. A feasibility study aims to answer these key questions: Does the system contribute to the overall objectives of the organization?, Can the system be implemented within schedule and budget using current technology? and Can the system be integrated with other systems that are used? (Sommerville, I. (2016). *Software Engineering*. 10th ed. Global Edition.) So accordingly in this section, we conduct a feasibility study to evaluate the resources required for its successful implementation and determine the likelihood of achieving the project's objectives.

1.4.1 Technical Feasibility

Technical Feasibility involves assessing whether the necessary tools and skills are available to complete a project. This initiative is considered viable because our current development resources and modern technologies are well-suited to meet the project's schedule.

The BookNest platform is designed as a Progressive Web Application (PWA) using modern, widely adopted technologies, including Next.js for the frontend, Node.js with Express for the backend, Supabase for database management, authentication, real-time and storage services, and PDF.js for in-app digital book reading. These technologies are stable, scalable, open-source, and supported by extensive documentation and active developer communities, which significantly reduces technical risk.

Table 1.1 hardware requirement

Item	Description	Availability
Development Devices	Laptops/PCs with Intel Core i5/i7, 8–16 GB RAM, 256 GB SSD	Owned by all team members (no cost)
Testing Devices	Smartphones for PWA testing	Team/personal devices
Production Environment	No physical hardware; cloud deployment on Vercel/Render/Supabase	Free tiers sufficient for prototypes.

Table 1.2 software requirement

Component	Description	Version	Availability
Frontend Framework	Used to develop the Progressive Web Application (PWA) user interface, routing, and rendering	Next.js	Free, open-source

Programming Language	Ensures type safety, maintainability, and reduced runtime errors	TypeScript (Latest Stable)	Free, open-source
Styling Framework	Utility-first CSS framework for responsive and accessible UI design	Tailwind CSS (Latest)	Free, open-source
PWA Support Library	Enables offline access, caching, and home-screen installation	next-pwa (Latest)	Free, open-source
Backend Runtime	Executes server-side logic and API services	Node.js (LTS)	Free, open-source
Backend Framework	Handles routing, middleware, and business logic	Express.js (Latest)	Free, open-source
Database Management System	Stores structured system data using relational database technology by using Supabase Service	Supabase database service (PostgreSQL)	scalable plans
Authentication & Realtime Services	Manages user authentication, authorization, and real-time data updates	Supabase Auth & Realtime	scalable plans
PDF Reader Library	Renders and interacts with PDF-based books in the browser	PDF.js (Latest)	Free, open-source
Development Tools	Source code editing, version control, UI design, and system modeling	VS Code, GitHub, Figma, Draw.io	Free

Conclusion: The chosen technology is capable, available, and well-understood by the team, making the project technically feasible.

1.4.2 Operational feasibility

Operational feasibility assesses how effectively the system will meet the operational needs and requirements of users. It focuses on evaluating how well the system will function in a real-world environment and whether it will be sustainable and practical for the intended users. The goal is to determine if the system can be effectively used within the current operational environment without causing significant disruptions or requiring excessive changes to current processes (Pressman, 2014).

For the BookNest digital reading platform, operational feasibility is assessed by evaluating how well the system supports the needs of the Ethiopian literary ecosystem—readers, authors, publishers, and administrators—and how seamlessly it integrates into existing digital practices, payment habits, and content consumption workflows. The platform is designed to enhance, rather than disrupt, current operations by formalizing and improving already familiar processes.

From an organizational and user perspective, BookNest aligns closely with existing behaviors. Ethiopian readers and authors already rely heavily on mobile devices, social media platforms, and messaging applications for discovering books, discussing literature, and sharing information. By offering similar interaction models—such as user profiles, following, commenting, and chat—within a single dedicated platform, BookNest minimizes resistance to adoption and reduces the need for extensive user training. As a Progressive Web Application (PWA), the system installs and operates like a mobile application while remaining accessible through standard web browsers, ensuring ease of use across different devices.

The payment process further strengthens operational feasibility. Chapa is a widely used and trusted mobile payment system in Ethiopia, making it an appropriate choice for digital transactions. We use Chapa because it provides a secure, fast, and locally supported payment solution in Ethiopia. It allows users to pay easily using mobile money, bank transfers, and cards, making the platform accessible and convenient for a wide range of users.

From an administrative standpoint, the system introduces manageable and clearly defined procedures without requiring major organizational restructuring. Administrators are responsible for user management and content approval through a centralized dashboard. These tasks are straightforward, well-defined, and scalable, making day-to-day system operation practical and sustainable.

To ensure operational effectiveness, usability testing will be conducted with representative Ethiopian users. This testing will validate the clarity of the Amharic and English interfaces, the ease of navigation, and the practicality of core workflows such as book purchase, reading, listening, and interaction. Feedback from this testing phase will be used to refine operational processes before full deployment.

In conclusion, the BookNest system demonstrates high operational feasibility. It is well aligned with existing user behaviors, integrates smoothly into current digital and payment practices, requires minimal organizational change, and is designed to be easily adopted and maintained. Therefore, the project is considered operationally viable with low operational risk.

1.4.3 Economic feasibility

Economic feasibility involves a thorough cost-benefit analysis to determine whether the projected benefits of the proposed system outweigh the estimated costs, making it a worthwhile investment. This analysis identifies and quantifies all relevant costs and benefits over a projected period.

A. Cost Identification

The costs for developing and operating the BookNest platform are categorized as one-time development costs and recurring operational costs.

1. One-time Costs

One-time costs refer to expenses associated with project initiation, development, and system start-up. These costs are incurred only once to design, build, configure, and launch the BookNest system. They include activities such as system development, initial configuration, data preparation, testing, and deployment.

For the BookNest Progressive Web Application (PWA), one-time costs are limited because the project utilizes open-source technologies and existing hardware resources. A one-time cost is therefore used to capture and estimate these expenses during the initial development and deployment phase.

Table 1.3: One-Time Cost for BookNest

Cost Category	Description	Estimated Cost (ETB)
Domain Name Registration (Initial Year)	Initial registration of the system domain	1,500
System Testing & Validation	Functional testing and user acceptance testing activities	2,500
Documentation & Printing	Final report preparation, printing, and binding	1,000

Total one-time cost: 5,000 ETB

2. Recurring (Operational) Costs

Recurring costs refer to expenses resulting from the ongoing use, operation, and evolution of the information system after deployment. These costs are incurred repeatedly (monthly or annually) throughout the system's operational life.

For the BookNest system, recurring costs mainly include application maintenance, cloud hosting services, data storage, communication services, and promotional activities necessary to sustain and grow the platform.

Table 1.4: Recurring Costs for BookNest

Service	Description	Estimated Annual Cost (ETB)
Supabase (Pro/Growth)	Database hosting, authentication services, and real-time chat functionality	7,000
Vercel (Pro)	Frontend hosting, CDN delivery, and deployment services	3,500

Backend API Hosting (Render)	Hosting and execution of Express.js backend services	4,000
Maintenance and Support	Ongoing bug fixes, system updates, and user support	5,000
Marketing and Promotion	Digital marketing to attract users, authors, and publishers	8,000

Total recurring cost: 27,500 ETB per Year

B. Benefit Identification

Benefits are categorized as tangible (quantifiable) and intangible (qualitative but significant).

1. Tangible Benefits:

Tangible benefits are those that can be measured objectively, often in monetary terms or through clearly observable operational improvements. Although not all tangible benefits can be easily converted into direct financial values, they represent real, measurable improvements in system performance.

Table 1.5: Estimated Annual Recurring Costs

Benefit Category	Description	Estimated Value
Cost Reduction – Physical Distribution	Elimination of printing, physical storage, and transportation costs by using digital (PDF and Audio) delivery	25,000 ETB per year
Cost Avoidance – Third-Party Platforms	Avoided fees and commissions paid to external marketplaces or intermediaries	18,000 ETB per year
Error Reduction	Fewer transaction and record-keeping errors through automated database and payment logging	8,000 ETB per year
Increased Sales Revenue (Commission)	Commission earned from digital book sales (estimated adoption phase)	35,000 ETB per year

Improved Efficiency	Time	Faster processing of purchases and access to books increases transaction volume	10,000 ETB per year
Market Expansion		Access to geographically dispersed users increases potential customer base	20,000 ETB per year

Total tangible benefit: 116,000 ETB Per Year

2. Intangible Benefits:

Improved Literary Ecosystem: Centralization and legitimization of the digital Ethiopian book market.

Enhanced Reader Engagement: Increased reading discipline and social interaction around books, potentially leading to a larger, more active readership.

Author-Publisher Empowerment: Direct access to market data and reader feedback, enabling better business and creative decisions.

Cultural Promotion: Promotion of Ethiopian literature and the Amharic language in the digital space.

Economic Feasibility Summary

The economic feasibility analysis of the BookNest project demonstrates that the system is financially viable and sustainable from the first year of operation.

Year 1

- Total Costs: 32,500 ETB (5,000 ETB one-time + 27,500 ETB recurring)
- Total Benefits: 116,000 ETB
- Net Gain: 83,500 ETB

The project recovers its initial investment within the first year, confirming the practicality of launching the system immediately.

Year 2 Onwards

- Total Recurring Costs: 27,500 ETB per year
- Total Benefits (Year 2): 121,800 ETB (assuming 5% annual growth)

- Net Gain (Year 2): 94,300 ETB

Long-Term Projection

- By the fifth year, cumulative net gains are approximately 111,700 ETB, with benefits growing annually due to operational improvements, increased efficiency, and user adoption.

1.4.4 Schedule Feasibility

Schedule feasibility relates to project duration and the likelihood that all potential time frames and completion date schedules can be met and are sufficient for dealing with the needs of the organization.(Modern Systems Analysis and Design). The project will be completed within the academic year, with careful allocation of resources and task dependencies.

- Project Timeline: A detailed Work Breakdown Structure (WBS) and project schedule (Gantt Chart) have been developed, allocating time for all phases: Planning & Requirements, System Design, Implementation, Testing, and Deployment.
- Risk Management: The schedule accounts for the complexity of developing three interdependent modules (Marketplace, Tracker, Social). The strategy to mitigate this risk includes parallel development tracks for frontend and backend components and prioritizing the completion of critical path items.

1.4.5 Legal feasibility

Legal feasibility is the process of assessing potential legal and contractual ramifications due to the construction of a system. Possible considerations might include copyright or nondisclosure infringements, labor laws, antitrust legislation , foreign trade regulations , and financial reporting standards, as well as current or pending contractual obligations.

- Content and Copyright: BookNest only distributes softcopy (PDF and Audio) files. Authors and publishers are required to legally declare and provide documentation of copyright ownership upon upload.
- Payment Compliance: Using Chapa avoids many of the legal and bureaucratic hurdles associated with direct banking integrations, while still providing a secure and compliant payment gateway.

- Data Security and Privacy: User data is protected using Supabase (which manages security and authentication), and the platform is designed to adhere to the relevant Ethiopian Personal Data Protection Proclamation No. 1321/2024 Personal Data Protection Proclamation.
- Content Moderation: An Admin moderation panel is a non-functional requirement, ensuring illegal or inappropriate content is immediately removed to maintain legal compliance and platform integrity

1.5 Significance of the Project

Ethiopian readers, authors, and small publishers currently face a fragmented digital ecosystem that limits book discovery, distribution, and engagement. This fragmentation reduces access to Ethiopian literature, prevents efficient reading tracking, and restricts opportunities for community interaction around books. The absence of a unified platform makes it difficult for readers to find reliable sources, for authors to reach their audience, and for the community to share cultural and intellectual experiences effectively.

A centralized platform like BookNest addresses these gaps by integrating a secure digital marketplace, automated reading-tracking, and a social reading community. By providing a single, bilingual hub for book discovery, purchase, and discussion, BookNest streamlines the reading experience, enhances trust in digital transactions, and encourages sustained engagement with local literature.

1.6 Beneficiaries of the Project

The Booknest platform functions as a diverse ecosystem, providing unique value and concrete advantages for three main groups. The project's effectiveness is assessed by how well it addresses the specific requirements of each of these stakeholders.

1. Readers

Readers are the primary consumers within the Booknest ecosystem. They transition from passive consumers to active community members.

- Centralized Access: Readers benefit from a single, dedicated platform to purchase a wide range of books directly from authors and publishers.

- Personalized Reading Management: The "Book Shelf" and "Tracking System" empower readers to manage their personal library, plan their reading, and track their progress, all in one place.
- Direct Creator Access: Readers can follow their favorite authors and publishers, receiving direct updates, short stories, and other exclusive content.
- Community & Connection: The social features provide a dedicated space for readers to find and connect with like-minded individuals, add friends, chat, and participate in groups focused on specific genres, books, or authors.

2. Authors

Booknest provides authors with the tools to manage both their creative work and their career.

- Direct Sales Channel: Authors gain a new, direct-to-consumer marketplace to sell their books, potentially leading to higher profit margins and a more direct relationship with their buyers.
- Targeted Marketing & Promotion: The platform acts as a powerful marketing tool, allowing authors to advertise their books directly to an engaged audience of active readers.
- Audience Building & Direct Engagement: Authors can post original content (like short stories), share updates, and interact with their followers, building a loyal fanbase and fostering a community around their work.

3. Publishers

Publishers benefit from a modern, integrated platform that combines sales, marketing, and community engagement.

- New Digital Distribution Channel: Booknest serves as a new sales channel to add their complete catalog of books to the store, reaching a wide and relevant audience.
- Targeted Advertising & Publicity: Publishers can use the social features to post information, advertise new releases, and promote their entire list of authors to a dedicated readership.
- Community Insights: By observing reader groups and discussions, publishers can gain valuable insights into market trends, reader preferences, and emerging sub-genres.

1.7 Methodology

A methodology is a formalized approach to implementing the SDLC (i.e., it is a list of steps and deliverables) (System Analysis and Design, fifth edition). The methodology section describes the systematic approach used to gather requirements, validate the problem, and develop BookNest. It ensures that the platform is built on real user needs and follows industry best practices, and remains aligned with the project's industrial (real-world, scalable, revenue-generating) goals.

1.7.1 Data Collection

Accurate and comprehensive data collection is essential to inform both the initial system specifications and ongoing design decisions. For this project the data mainly will be gathered by using interviews, questionnaires and direct observation.

A. Primary Data Collection

- Stakeholder Interviews: Semi-structured interviews will be conducted with target users (Ethiopian readers, authors, and small publishers) to elicit in-depth qualitative data on their current workflows, pain points, and feature expectations.
- Surveys & Questionnaires: Online surveys will be distributed to a broader audience to gather quantitative data on user demographics, reading habits, digital payment usage, and platform feature prioritization.
- Direct Observation: Observing potential users as they interact with existing tools (e.g., PDF readers, social media groups for book sales) will provide insights into usability challenges and inform the design of more intuitive interfaces.

B. Secondary Data Collection

- Literature Review: Academic and industry literature on digital publishing platforms, PWA technology, reading analytics, and the Ethiopian digital economy will be reviewed to establish foundational knowledge and identify best practices.
- Document Analysis: Existing forms, reports, and informal workflows currently used in the local book ecosystem will be analyzed to understand data requirements and process inefficiencies.

1.7.2 System Development Methodology

The development of BookNest will follow a two-stage hybrid methodology. This model is designed to provide the necessary structure for academic documentation and planning, followed by the flexibility needed to manage development complexity and incorporate feedback.

Stage 1: Structured Analysis and Design Phase

This initial phase will employ a plan-driven, waterfall-inspired approach focused on creating a stable and detailed foundation. The activities in this phase are largely sequential and document-centric, which is appropriate when requirements need to be well understood and agreed upon before significant development begins. The deliverables of this phase are the core components of this documentation and a fully specified system design. This aligns with project scenarios where early planning reduces downstream risk.

Stage 2: Iterative Agile Development Phase

Following the approval of the design specifications, the project will transition to an Agile methodology utilizing Scrum practices. This phase is characterized by short, time-boxed iterations (sprints), incremental delivery of working software, and continuous stakeholder feedback.

Framework: Scrum.

- Roles: Product Owner (manages the backlog), Scrum Master (facilitates process), and Development Team (cross-functional implementers).
- Artifacts: Product Backlog (prioritized features from the specifications), Sprint Backlog (tasks for the current iteration), Increment (shippable product functionality).
- Events: Sprint Planning, Daily Stand-ups, Sprint Review, and Sprint Retrospective.
- Justification for Agile: The complexity of integrating the marketplace, tracker, and social modules introduces uncertainty. An iterative approach allows the team to tackle high-risk components early, adapt to technical challenges, and refine features based on ongoing testing and user feedback, thereby maximizing the value of the working product.
- Integration of the Two Stages: The hybrid methodology is not a compromise but a strategic integration. The detailed artifacts (requirements, models, prototypes) produced in Stage 1 will populate the initial Product Backlog for Stage 2. This ensures that agile development proceeds with a clear, validated direction, avoiding the vagueness that can plague purely agile projects with no upfront analysis. This

combination leverages the strengths of both paradigms: thorough planning and adaptive execution.

1.8 Development Tools and Technologies

This section describes the technologies, tools, and environments used to design, develop, document, and deploy the BookNest Progressive Web Application (PWA). The selection of technologies is based on scalability, performance, modern development standards, and alignment with the Ethiopian digital ecosystem.

1.8.1 Frontend Technologies

The frontend of BookNest is implemented using modern, high-performance web technologies that support PWA capabilities, multilingual UI rendering, responsive layout, and offline functionality.

1. Next.js (React Framework)

- Used as the primary frontend framework.
- Provides server components, app router, and built-in SEO optimization.
- Supports high performance, incremental static regeneration (ISR), edge rendering, and routing.
- Perfect for PWA development.

2. React + TypeScript

- Ensures type safety, maintainability, and fewer runtime errors.
- Enables reusable UI components for Marketplace, Reader, Dashboard, and Community modules.

3. Tailwind CSS

- Utility-first CSS framework used for fast and consistent styling.
- Provides responsive UI design and reduces CSS file size.
- Enhances accessibility and theme-based styling for both Amharic and English interfaces.

4. Next-PWA

A PWA plugin that generates a service worker and manifest.json Enables:

- Offline reading for purchased books,
- Add-to-home-screen installation,
- Background sync,
- Fast loading through caching strategies

5. PDF.js (In-App Reader Libraries)

- Enable rendering and interaction with PDF files directly in the browser.
- Support pagination, zooming, highlighting, and reading progress tracking.
- PDF.js is used for PDF books.

6. Axios & React Query

- Axios handles HTTP requests to the backend.
- React Query manages caching, server-state synchronization, and real-time UI updates.

7. Figma (UI Design)

- Used to design wireframes, high-fidelity prototypes, and user-flow diagrams.
- Ensures a consistent user experience across devices.

1.8.2 Backend Technologies

This section focuses on the server-side logic, database management, authentication, and real-time capabilities required to support the PWA's complex features, such as e-commerce, user profiles, and the social community.

- Node.js + Express Framework:
 - This serves as the core Application Programming Interface (API) layer.
 - Express is used to handle complex business logic, including secure user session management, processing requests from the Next.js frontend, and controlling data flow.

- o Crucially, it implements the *Reader Tracking Logic*—dedicated endpoints receive raw progress data from the PDF.js readers, calculate reading streaks, update page progress, and ensure data is securely committed to the database.
- Supabase (database, Auth, Realtime, Storage):
 - o Acts as a complete Backend-as-a-Service (BaaS) solution.
 - o Provides a robust PostgreSQL database for structured data.
 - o Handles built-in user *Authentication*.
 - o Enables *Realtime* features for instantaneous updates in the chat system and live progress tracking dashboard.
 - o Manages secure storage of digital content including PDF books, audio files, cover images, and user-uploaded media, with controlled access integrated with Supabase authentication

1.8.3 Documentation and Model tools

This section presents the tools used for system documentation, analysis, and modeling.

1. Figma (Interface Prototyping & UX Flow)

Used to design complete screens for:

- Marketplace
- Book Reader
- Dashboard
- Chat System
- Author Panel
- Supports collaborative design within the team.

2. Draw.io / diagrams.net

It Used for drawing:

- Use-case Diagrams
- Sequence Diagram
- Class Diagram
- Completely free and cloud-based.

3. Microsoft Word / Google Docs

Used for preparing the final documentation and formatting based on department guidelines.

4. GitHub

Used for:

- Version control,
- Collaboration,
- Pull requests and code reviews,
- Project management using GitHub Projects.

5. Visual Studio Code

- The Main IDE for development.
- It Includes extensions for Next.js, Tailwind, TypeScript, Git, and ESLint.

1.8.4 Deployment Environment

BookNest is deployed using cloud-native platforms selected for reliability, global performance, and cost efficiency. The architecture utilizes a single primary domain with a subdomain structure.

- Vercel (Frontend Deployment):
 - Used as the primary deployment platform for the Next.js PWA Frontend.
 - Provides automatic Continuous Integration/Continuous Deployment (CI/CD) and a global edge network for fast static file serving, aligning with the PWA's performance requirements.
 - Hosts the application on the primary domain (e.g., booknest.com.et).
- Render / Dedicated Host (Backend API Deployment):
 - A reliable, scalable cloud hosting platform (like Render or Fly.io) is used to deploy the *Node.js + Express Backend API*.
 - Separating the API from the frontend host ensures optimal performance for the heavy computational tasks (like transaction processing and tracking logic).
 - The API is hosted on a *subdomain* (e.g., api.booknest.com.et), keeping the entire system under one logical domain structure.

- Supabase:
 - The *Database, Authentication, and Realtime Engine* services are deployed and managed directly by the Supabase platform, running on optimized PostgreSQL infrastructure.

1.9 Scope

The project scope defines the official boundaries of the BookNest system, specifying the features and functionalities that will be developed and delivered within the 8-month project timeline..

1.9.1 In-Scope Features

The following core features will be fully functional and delivered as part of the system:

Digital Book Marketplace Module:

- User registration and role-based profiles for *Readers, Authors, and Publishers*.
- A catalog for browsing and searching digital books that include only Ethiopian novels, available in different languages (PDF and audio formats).
- A secure purchasing workflow where readers complete payments through Chapa, with automatic verification and instant digital delivery of the purchased book to their personal library.

Smart Reading Tracker & Digital Bookshelf Module:

An integrated in-application reader for PDF files.

- Automatic tracking of reading or listening progress (pages read, time spent) per session.
- Calculation and display of user reading statistics, including daily/weekly streaks, overall progress percentage.
- A personal dashboard visualizing reading analytics and housing the user's purchased book collection.

Social Community Module:

- User profiles with the ability to follow other users and authors.

- A community feed for creating posts and comments about books.
- Real-time chat functionality, supporting both one-to-one and group-based chat for book clubs or discussion groups.
- The ability to create, join, and manage chat groups.

1.9.2 Out-of-Scope Features (Future Development)

The following are explicitly excluded from the current project to ensure focus and timely delivery of the core functionality:

- Advanced Analytics & AI: A machine learning-based recommendation engine for books and the development of a premium, in-depth analytics dashboard for authors/publishers are excluded.
- Advanced Social Features: Integration with external social media platforms, complex news feed algorithms, and video/voice chat capabilities are excluded.
- Advanced Content Management: Features such as version control for uploaded books, automated plagiarism checking, and sophisticated Digital Rights Management (DRM) beyond platform-level access control are excluded.
- Mobile Native Applications: Development of dedicated iOS or Android applications from the ground up is excluded. The platform will be delivered as a Progressive Web App (PWA) accessible on all devices

1.10 Risks, Assumptions, and Constraints

This section identifies the potential uncertainties (risks), accepted premises (assumptions), and fixed limitations (constraints) for the BookNest project. Proactively managing these elements is a fundamental activity in software project management to increase the likelihood of success.

1.10.1 Project Risks

A project risk is an uncertain event that, if it occurs, has a positive or negative effect on the project's objectives. The following table identifies the key foreseeable risks, their assessment, and planned mitigation strategies.

Table 1.6: Identified Project Risks and Mitigation Strategies

Risk Category & Description	Likelihood	Impact	Mitigation Strategy
Technical Risk: Failure in the integration of key real-time components (chat, reading progress sync) due to Supabase Realtime complexity.	Medium	High	Conduct a focused proof-of-concept on core real-time features early in the development cycle to validate the architecture.
Business/Adoption Risk: Low initial uptake by Ethiopian authors and publishers, leading to an empty marketplace.	Medium	High	Run campaigns and workshops to show platform benefits. Offer incentives like discounts and promotions. Collaborate with local authors and publishers to onboard content.
Legal and Intellectual Property Risks: Unauthorized copying and sharing of sold digital books, undermining the revenue model.	High	Critical	Implement platform-level DRM: books only accessible through the PWA reader/bookshelf, prevent direct source file downloads, and watermark purchased copies.

1.10.2 Project Assumptions

Assumptions are factors that, for planning purposes, are considered to be true, real, or certain without definitive demonstration. The project plan is based on the following critical assumptions:

- Stakeholder Engagement: Ethiopian readers, authors, and publishers will be willing and available to provide feedback during requirements gathering and testing phases.
- Technology Stability: The core technologies (Next.js, Supabase, etc.) and their key APIs will remain stable and supported for the duration of the project.
- Resource Availability: Team members will have consistent access to necessary development hardware, software, and a reliable internet connection.
- Market Practice: The target user base has sufficient familiarity with mobile payments (Chapa) to successfully complete the payment.

- Data Availability: A sufficient amount of legally distributable Ethiopian digital book content can be acquired for testing and launching the marketplace.

1.10.3 Project Constraints

Constraints are immutable restrictions that limit and define the project's execution. The BookNest project operates within the following fixed constraints:

- Time Constraint: The project must be completed within a strict 8-month academic timeline, dictating the scope and necessitating efficient time management
- Technical Constraint: The application must be delivered as a Progressive Web App (PWA) to ensure cross-platform accessibility without developing separate native mobile applications.
- Regulatory Constraint: The system must be designed to comply with Ethiopian copyright law and general principles of user data privacy.
- Resource Constraint: 6-person team with academic commitments.

1.11 Phases and Deliverables of Project

The BookNest project follows the hybrid methodology defined in Section 1.7. Each phase represents a distinct set of activities with specific, measurable deliverables that build upon one another to ensure systematic progress toward project completion. This approach facilitates clear planning, monitoring, and control throughout the 8-month project lifecycle.

Table 1.7: Project Phases and Deliverables

Phase	Key Activities	Primary deliverables
Phase I: Planning and Problem Identification	<ul style="list-style-type: none"> • Finalize project scope and objectives • Conduct feasibility study • Develop initial project plan 	<ol style="list-style-type: none"> 1. Initial Project Plan & WBS 2. Chapter 1 Documentation

Phase II: Business Area Analysis and Requirements Definition	<ul style="list-style-type: none"> • Conduct stakeholder analysis • Document business processes • Define functional & non-functional requirements 	<ol style="list-style-type: none"> 1. Business Area Analysis 2. Requirements Specification definition 3. Chapter 2 Documentation
Phase III: System Design & Modeling	<ul style="list-style-type: none"> • Perform object-oriented analysis (use cases, class , sequence diagrams) • Create UI prototypes 	<ol style="list-style-type: none"> 1. Object-Oriented Analysis 2. UI Prototype 3. Chapter 3 Documentation
Phase IV: Development & Integration	<ul style="list-style-type: none"> • Sprint planning and backlog refinement • Incremental development of core modules • Continuous integration 	<ol style="list-style-type: none"> 1. Working System Increments 2. Updated Source Code 3. Integration Test Reports
Phase V: System Testing & Quality Assurance	<ul style="list-style-type: none"> • Comprehensive testing (unit, integration, system) • User Acceptance Testing (UAT) • Performance testing 	<ol style="list-style-type: none"> 1. Test Plan and Results 2. UAT Sign-off 3. Performance Report
Phase VI: Deployment & Project Closure	<ul style="list-style-type: none"> • Production deployment • Final documentation • Project review 	<ol style="list-style-type: none"> 1. Deployed Live System 2. Final Complete Documentation 3. Project Closure Report

1.12 Work Breakdown Structure (WBS)

The Work-Breakdown Structure decomposes the BookNest project into manageable work packages, providing a hierarchical view of all tasks required for successful completion.

Table 1.8: BookNest Project Work-Breakdown Structure with Resource Allocation

WBS ID	Task list	Task description	Assigned Team
1	Project Initiation	The initial phase in which a project idea is formally identified, justified, and authorized to begin.	All Members
1.1	Research and Problem identification	The process of studying the current situation to identify existing problems, gaps, and user needs that the project aims to address.	Tsion, Soleni, Hewan
1.2	Project Proposal and Approval	A formal document that outlines the project objectives, scope, methodology, and feasibility, submitted for evaluation and official authorization.	Tsion, All Members
2	Introduction	A section that provides background information about the project, its context, and the motivation for its development.	All Members
2.1	Objectives (General and Specific)	Clearly defined goals of the project, where the general objective states the overall aim and the specific objectives	Tsion, Soleni, Hewan

		describe measurable steps to achieve it.	
2.2	Feasibility study	An evaluation of the technical, operational, economic, and schedule viability of the proposed system.	Tsion, Nigist, Mihret
2.3	Significance and Beneficiaries	A section that explains the importance of the project and identifies the individuals or groups who will benefit from it.	Nigist, Mihret, Rewda
2.4	Methodology and Tools	The development approach and technologies used to design, implement, and evaluate the system.	Tsion, Soleni, Hewan
2.5	Scope, Risks, Assumptions, and Constraints	This define the boundaries of the project by specifying what is included and excluded, identifying potential uncertainties that may affect success, stating conditions presumed to be true, and outlining limitations related to time, resources, budget, or technology.	Tsion, Nigist, Mihret

2.6	Phases and Deliverables, WBS, and Schedule	This outlines the stages of project execution, the tasks required to produce outputs, and the timeline for completion.	Tsion, All Members
3	Business Area Analysis and Requirements Definition	This is the process of examining the organizational context and user needs to identify problems and formally specify the functional and non-functional requirements of the proposed system.	All Members
3.1	Business area analysis	This is the systematic examination of an organization or domain to understand its processes, stakeholders, problems, and needs that the proposed system aims to address.	Nigist, Mihret, Rewda
3.2	Functional Requirements Definition	Functional requirements definition is the process of specifying what the system must do, including the services, behaviors, and functions it must provide to users.	Tsion, Soleni, Hewan

3.3	Non-Functional Requirements Definition	Non-functional requirements definition is the process of specifying the quality attributes and constraints of a system, such as performance, security, usability, reliability, and scalability.	Tsion, Nigist, Mihret
4	Object-Oriented Analysis	It is a system analysis approach that models a system as a collection of interacting objects representing real-world entities and their behaviors.	All Members
4.1	Use Case Modeling	Use case modeling is a technique used to identify and describe system functionalities by illustrating interactions between users (actors) and the system	Tsion, Soleni, Hewan
4.2	Conceptual Modeling	Conceptual modeling is the process of creating abstract representations of a system, illustrating its key entities, attributes, and relationships to support analysis and design.	Tsion, Nigist, Mihret
4.3	Sequence Diagramming	Sequence diagramming is a modeling technique that visually represents the order of	Tsion, Soleni, Hewan

		interactions between objects or components in a system to accomplish a specific function or process.	
4.4	User Interface Prototyping	User interface prototyping is the process of creating an early, interactive version of a system's interface to visualize design, gather user feedback, and validate usability before full development.	Hewan, Rewda, Mihret
5	Implementation & Development	It is the phase in which the system is built, coded, and configured according to the design specifications, transforming models and plans into a functional software product.	Development Team
5.1	Development Implementation	It is the phase in which the system design is translated into actual code, configured, and integrated to produce a working software product.	Full Team
6	System Testing & Quality Assurance	It is the process of evaluating the complete system to ensure it meets all requirements, functions correctly, and	All Members

		maintains the desired level of quality before deployment.	
6.1	Unit Testing	Unit testing is the process of verifying that individual components or modules of a system function correctly in isolation.	Developers per module
6.2	Integration Testing	Integration testing is the process of combining individual components or modules of a system and testing them together to ensure they work correctly as a group.	Tsion, Soleni
6.3	System Testing	System testing is the process of evaluating the complete integrated system to verify that it meets specified requirements and functions correctly under various conditions.	All Members
6.4	User Acceptance Testing (UAT)	It is the process in which end-users evaluate the system to ensure it meets their requirements and functions correctly in real-world scenarios before final deployment.	All Members

7	Deployment & Project Closure	It is the phase in which the system is implemented in the live environment, user acceptance is confirmed, and all project activities are formally completed and documented.	All Members
7.1	Production Deployment	It is the process of releasing the completed system into a live environment where it can be accessed and used by end-users.	Tsion, Backend Team
7.2	Final Documentation & Project Report	It is the comprehensive record of the project, including its objectives, design, development process, testing, results, and conclusions, prepared for evaluation and reference.	All Members

1.13 Project Schedule

The project schedule provides a temporal visualization of the BookNest project plan, mapping all work packages from the WBS against the 8-month timeline. The schedule is presented as a Gantt chart, which illustrates task durations, dependencies, and concurrent activities, enabling effective project monitoring and control.

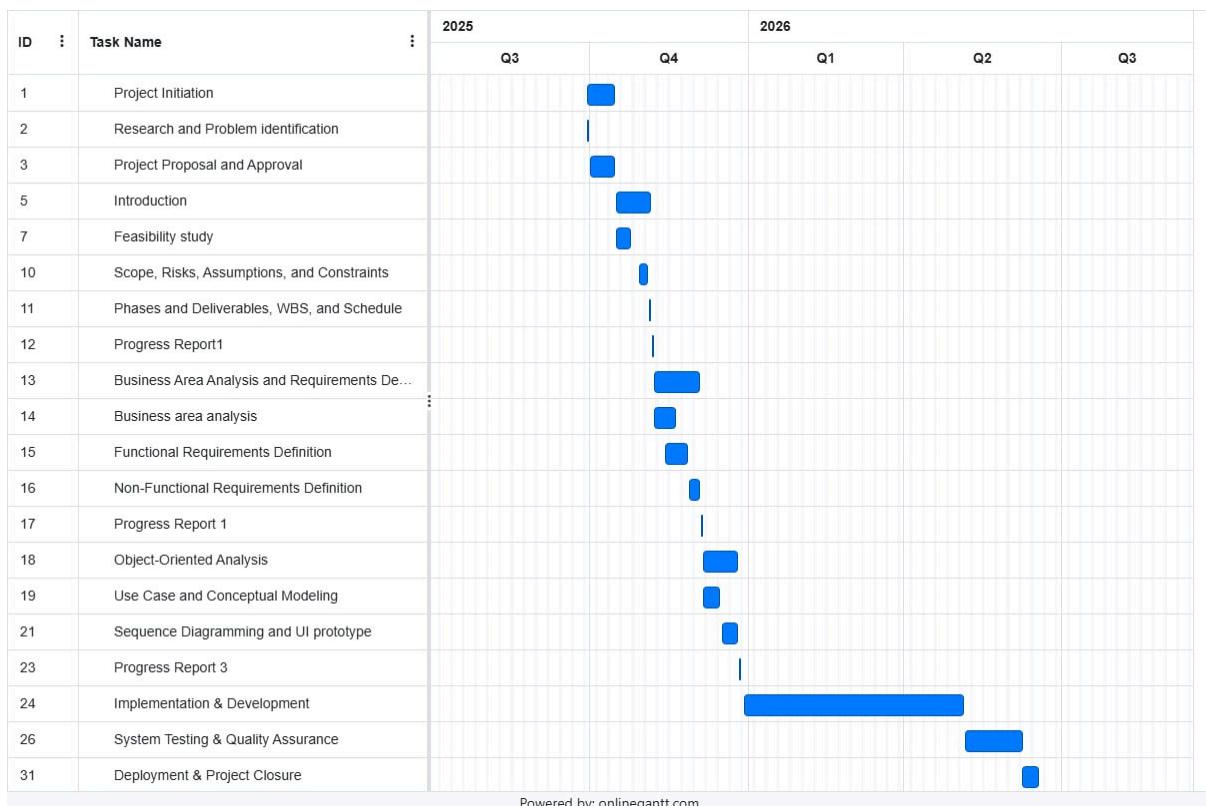


Figure 1.1: Gantt chart

Chapter two: Business Area Analysis and Requirement Definition

2.1 Overview

This chapter presents a detailed analysis of the business environment and system requirements related to the BookNest project. It begins by examining the existing digital book ecosystem in Ethiopia, focusing on how books are produced, distributed, read, and discussed using current tools and platforms. The chapter then analyzes the functions, activities, problems, and stakeholders of the existing system in order to identify its limitations and inefficiencies. Based on this analysis, the chapter defines the functional and non-functional requirements of the proposed system, establishing a clear foundation for system design and implementation in subsequent chapters.

2.2. Business Area Analysis

Business area analysis is a structured process of examining the specific operational domains of an organization to gain a detailed understanding of its workflows, challenges, and opportunities. It focuses on identifying inefficiencies and aligning processes with the organization's strategic objectives to enable informed decision-making and system improvements. (Alter, S., 2017)

For the BookNest project, the "business area" encompasses the entire ecosystem of digital book production, distribution, reading, and community interaction in Ethiopia, not just the software.

The current digital reading ecosystem in Ethiopia is a functionally fragmented environment defined by a necessary but inefficient combination of digital platforms and manual procedures. In Digital E-commerce, platforms like Tuba and AfroRead provide local payment and catalog features, yet these are undermined by the reliance on Manual File Delivery and seller-performed Manual Payment Verification (often involving Telebirr/CBE Birr), which results in high piracy risk and a lack of transactional trust.

For Reading Management, users are granted Offline Reading via Generic PDF Viewers like Adobe Acrobat and WPS Office, but the critical feature of real-time progress logging is absent. This forces users to engage in Manual Progress Logging using external Note Apps like Google Keep, iOS Notes with Calendar and Spreadsheets for manual goal setting leading to forgotten goals and data synchronization failures. Community Engagement is relegated to chaotic, unorganized, and non-contextual Telegram Channels and Facebook Groups.

2.2.1 Functions and Activities of the Existing System

This section defines the core functions and activities of the primary stakeholder groups that constitute the Ethiopian Digital Literary Ecosystem. A *Function* is defined as a major, high-level, logical grouping of related processes or activities that together achieve a key business purpose.

A function represents a core module or capability of the organization.

An *Activity* is a specific, discrete task or set of steps performed to transform an input into a defined output. Activities are the detailed, actionable procedures that constitute a larger function.

The existing system currently performs three main functions, each supported by highly fragmented activities:

Function 1: Digital Content Distribution & Sales (E-commerce)

Definition: The entire process required to market, sell, and securely deliver an e-book from the author/publisher to the reader.

Key activities:

- Product Advertising: Authors and publishers use general-purpose social media platforms like telegram and face book to post basic text, images, or short videos promoting a book. This activity often involves simple outbound marketing efforts with no targeted advertising tools tied to the sales platform.
- Payment Processing: The reader initiates a Person-to-Person (P2P) mobile money transfer (Telebirr, CBE Birr) to the seller's phone number often by demanding a

screenshot of the transfer receipt sent through a separate chat application or uses a local e-book app that has integrated these options like tuba and afroread which allow users to select telebirr at checkout and process the payment through telebirr's dedicated web payment page or API, automatically confirming the transfer to the merchant.

- Content Delivery: After the seller verifies the payment, they must then Manually Email or Message the book file (PDF) to the reader via an app like Telegram or WhatsApp. This is done outside the secure environment of the e-book application itself.
- Usage Tracking: Dedicated platforms like Tuba or AfroRead log the completed sale in their internal database, recording the book title and the user ID. This is the only fully digital step in the process.

Function 2: Reading & Progress Data Management (Tracking)

Definition: The process of consuming the book and recording the reader's progress, notes, and goals. . In the existing Ethiopian digital reading ecosystem, this function is severely under-automated, relying on the user to manually perform steps that modern digital systems handle automatically.

Key activities:

- Content Viewing: The reader opens the purchased eBook in a generic viewing application like Adobe Acrobat or uses the basic reader within the local e-book app (Tuba/AfroRead). These generic apps have no intelligence. They are simply file renderers and are not tied to an account, meaning they cannot report reading statistics, pace, or even the current page number back to a central server.
- Progress Logging: When the reader decides to stop reading (e.g., leaving for the day, switching devices), they must Manually Record the exact page number or chapter name. This record is made in an external, general-purpose tool like Google Keep, a note app, or a simple paper log. Problem: This activity is prone to error (forgetting the page), disruptive to the reading flow, and often leads to the complete abandonment of tracking.

- Goal Tracking: Readers who wish to set reading targets (e.g., "Read 50 pages today" or "Finish the book by next Friday") must use separate applications like a Calendar, Spreadsheet, or a custom Notion/Excel template. Problem: These goals are External to the reading application. There is no feedback loop; the reader does not see their progress bar update in real-time, leading to poor accountability and high drop-off rates from goals.
- Progress Synchronization: There is no Activity at all to link the reader's progress across devices. A reader who logs their progress manually on their phone cannot retrieve that information when opening the book on their tablet or desktop. The reader is often forced to start reading from a known prior point or manually search for their last page, creating unnecessary friction and frustration.

Function 3: Literary Community & Social Engagement (Community)

Definition: These systems facilitate discussion and interaction among readers and authors.

Key Activity:

- Review and Rating: Readers provide a star rating (e.g., 1-5 stars) and submit a short textual review on the book's product page within existing e-book apps (Tuba/AfroRead). Problem: This interaction is Static. It is a one-time feedback mechanism that offers minimal space for peer discussion, and the reviews are often isolated on the specific platform, lacking visibility across the wider community.
- Discussion: Readers engage in large, general-purpose Telegram Channels or Facebook Groups dedicated to Ethiopian literature. Problem: This discussion is Chaotic and Non-Contextual. Messages flow rapidly, making it impossible to refer back to a specific quote or page number. Conversations are easily lost, often off-topic, and there is no automatic spoiler protection, which ruins the reading experience for those behind the pace.
- Book Club Coordination: Process: Members of a book club must Manually Coordinate all logistics—choosing the next book, setting meeting times, and assigning weekly reading targets—through external chat apps or phone calls. Problem: This process is highly tedious, prone to schedule conflicts, and lacks automated tracking.

There is no system to verify if members have completed the assigned reading, leading to poor accountability and high member drop-off.

- Author Interaction: Readers seeking personalized feedback or asking detailed questions must send Direct Messages to the author's personal Social Media account (e.g., Telegram, Facebook). Problem: This process burdens the author with managing a flood of individual messages, diverting their time from writing, and the Q&A is not shared with the broader community.

2.2.2 Problem of the current system

The existing digital book ecosystem was evaluated using the PIECES problem-solving framework (Performance, Information, Economics, Control, Efficiency, and Service) to systematically identify key limitations. The analysis reveals that the current system is fragmented, inefficient, economically unsustainable, and poorly controlled, resulting in significant challenges for readers, authors, and sellers.

A. Performance Problems

From a performance perspective, the current system lacks an integrated digital reading platform capable of supporting end-to-end services. Users are unable to perform essential activities—such as purchasing books, reading digital content, tracking reading progress, reviewing books, and participating in discussions—within a single system. Instead, they must rely on multiple independent applications (e-commerce sites, PDF readers, social media platforms, and messaging apps).

This fragmentation significantly increases user workload and task completion time, as users must repeatedly switch between platforms to accomplish related activities. Consequently, system throughput is reduced, and overall user performance is negatively affected.

B. Information Problems

The existing system fails to generate and present meaningful reading-related information. It does not support structured data outputs such as reading progress indicators, reading streaks, estimated completion time, or personalized analytics dashboards. Although users interact with digital reading materials, the system does not capture, process, or transform this data into useful information.

As a result, users are unable to monitor their reading behavior, evaluate their engagement patterns, or make informed reading decisions. This lack of accurate, timely, and useful information significantly limits the system's effectiveness and value.

C. Economic Problems

Economically, the current system does not provide a reliable digital marketplace for the sale and distribution of ebooks in formats such as PDF and audio. Many local platforms lack secure digital delivery mechanisms and do not offer features that allow authors to upload, price, and monetize their content effectively.

Due to these limitations, readers frequently obtain books from unauthorized sources such as Telegram channels, leading to widespread revenue loss for authors and sellers. In addition, some platforms require buyers to communicate directly with sellers through social media, increasing transaction costs, reducing scalability, and weakening the overall economic sustainability of the system.

D. Control Problems

The existing system exhibits significant control and security weaknesses. There are no effective access control mechanisms, authentication policies, or digital rights management (DRM) solutions to protect digital content. Once a book is downloaded, it can be freely copied and redistributed without restriction.

This lack of control enables unauthorized distribution, violates intellectual property rights, and undermines trust among authors, sellers, and users. The absence of enforceable security policies represents a critical control failure within the current system.

E. Efficiency Problems

In terms of efficiency, the system forces authors and content creators to rely on multiple disconnected platforms to communicate with readers, promote books, and share updates. Activities such as audience engagement, content promotion, and feedback collection must be repeated across different social media channels.

This duplication of effort results in wasted time and resources, reduces productivity, and lowers the effectiveness of author–reader interactions. The system therefore fails to support efficient use of human and technological resources.

F. Service Problems

From a service quality perspective, the current system does not support a structured or reliable digital reading community. Literary discussions are scattered across social media platforms such as Telegram and Facebook, which lack proper moderation, search functionality, topic organization, and persistent discussion history. This leads to inconsistent user experiences and reduced service satisfaction.

Furthermore, while offline reading is an important user requirement, the absence of controlled offline access mechanisms allows downloaded books to be shared freely. This not only affects content security but also reduces service reliability for sellers by diminishing legitimate purchases and expected revenue. As a result, the overall quality, consistency, and trustworthiness of the service are compromised.

2.2.3 Forms and Reports in the Existing System

In the current book purchasing and delivery processes in Ethiopia, forms are mostly manual or semi-digital (paper-based or simple web forms). They collect basic buyer information and order details, but lack integration with digital payment.

2.2.3.1 Existing Forms

Standard Checkout Form

This form is used by EthioBookReview to allow users to request physical book delivery. (see [appendix](#))

This form is also used by EthioBookReview. Users select their preferred payment method, complete the payment, and then enter their phone number in the form. Administrators verify the payment, after which the user is granted access to the purchased book. (see [appendix](#))

This form appears on Booksite Ethiopia website selling physical books. It collects billing and delivery details before order placement. (see [appendix](#))

2.2.4 Players of the Existing System

The players of the existing system were identified using the *Stakeholder Analysis Framework*, which classifies individuals and groups based on their level of interaction and interest in the

system. A stakeholder is any person, group, or organization that directly or indirectly interacts with, influences, or is affected by the system (Kendall, K. E., & Kendall, J. E., 2014).

Based on this framework, the players of the existing system are categorized as *primary stakeholders*, *secondary stakeholders*, and *external stakeholders*.

A. Primary Stakeholders

These are the players who *directly interact* with the existing system and form the core users.

Readers

Individuals who search for books, purchase digital copies through informal channels, read PDF or audio files using generic reader applications, and participate in book discussions through social media platforms.

Authors

Content creators who write books and share or sell digital books through social media platforms, messaging applications, or informal online channels.

Publishers

Entities involved in producing and distributing books, primarily relying on physical distribution or informal digital sharing methods.

Visitors (Unregistered Users)

Visitors are individuals who access existing book-related web platforms and mobile applications without creating an account. They are able to browse book listings, search for content, read previews, and view public reviews. Their interaction is limited to observation and exploration, and they typically use the system to evaluate whether registration is necessary for full access.

B. Secondary Stakeholders

These stakeholders do not directly use the system but have an interest in its operation, outcomes, or management.

Platform Administrators (Informal Page Managers)

Individuals who manage Telegram channels, Facebook pages, Website, mobile applications or groups used for promoting and distributing books.

Technical Support Individuals

People who provide informal technical assistance related to file sharing, device usage, or payment confirmation issues.

C. External Stakeholders

These are entities outside the system boundary that influence or are influenced by the existing system.

Payment Service Providers

Mobile payment platforms used for informal digital transactions during book purchases.

Government and Regulatory Bodies

Institutions responsible for regulating digital content distribution, copyright, and data protection.

Internet and Network Service Providers

Organizations that provide connectivity enabling access to online platforms and digital content.

The existing system involves multiple players operating through fragmented and informal digital channels. The absence of a centralized, structured system leads to unclear interactions among stakeholders, limited trust, and inefficiencies in digital book distribution and community engagement. Identifying these players using the Stakeholder Analysis Framework provides a clear foundation for defining the requirements of the proposed system.

2.3 Requirement Definition

A requirement is a statement of what the system must do or what characteristics it needs to have.

2.3.1 Functional Requirements

Functional requirements for a system describe what the system should do and depend on the type of software being developed, the expected users, and the general approach taken by the organization. They are statements of services the system should provide, how the system should react to particular inputs, and how the system should behave in particular situations.(Software Engineering - Ian Sommerville)

Digital Book Marketplace

- Authors and publishers upload PDF or audio books with title, description, category, and price.
- Readers can browse, search, filter, and buy books.

Smart Reading Tracker

- In-app PDF reading and audio listening with auto progress tracking (pages read, time spent).
- Calculates reading streaks.
- The dashboard displays reading analytics.

Digital Bookshelf

- Users store purchased books.
- Offline reading is supported via PWA.
- Sync progress when online.

Social Community

- Users can follow authors, post, comment, and like.
- Real-time chat using Supabase Realtime.
- Basic reading groups or book clubs.

Admin Panel

- Approve author/publisher registrations.
- Manage content (books, posts, users).
- Generate basic reports.

2.3.2 Non-Functional Requirements

Non-functional requirements are constraints on the services or functions offered by the system. They include timing constraints, constraints on the development process, and constraints imposed by standards. Non-functional requirements often apply to the system as a whole rather than individual system functions or services.(Software Engineering - Ian Sommerville)

Operational

- The system shall maintain 99% uptime using Vercel and Supabase.
- The application shall support offline reading through PWA caching.
- The system shall be cloud-native to support growing users and book collections.
- The codebase shall be modular and maintainable using Next.js and Express.
- The application shall provide monitoring, logging, and alerting for failures.

Performance

- The application shall load quickly using PWA caching.
- The system shall provide real-time updates for chat and analytics.
- The user interface shall be fully responsive across mobile, tablet, and desktop devices.
- The system shall scale horizontally to support concurrent users.
- Offline synchronization shall occur efficiently once connectivity is restored.

Security

- The system shall provide secure authentication using Supabase.
- The system shall enforce role-based authorization for all users.
- The application shall implement controlled DRM to prevent direct PDF and audio downloads.
- All data shall be encrypted in transit and at rest.
- The system shall maintain audit logs for critical user and admin actions.

Cultural and Political

- The application shall support a bilingual interface (Amharic and English).
- The system shall properly handle local language scripts, dates, and formatting.
- The user interface shall be culturally appropriate and accessible.
- The system shall comply with local copyright and content regulations.
- The platform shall include content moderation policies aligned with regional law

Chapter Three: Object-Oriented Analysis

3.1. Overview

Object-oriented analysis (OOA) helps define a system's problem by identifying key real-world and software objects involved. The main goal is to understand what needs to be built and clearly define the problem to be solved (Ambler, 2004).

For the BookNest Online Shopping, Book Community, and Tracking System, the analysis focuses on creating a user-friendly platform that enables efficient book purchasing, community interaction, and order tracking. The analysis makes use of system use cases, sequence diagrams, and class diagrams to illustrate user interactions, system workflows, and software components. This approach provides a clear understanding of how the system will operate, ensuring it meets user needs, supports seamless transactions, and enhances engagement within the book community.

3.2. Use case Modeling

A use case describes a particular interaction between an actor (user or system) and the system in order to accomplish a specific goal. It is an effective tool for identifying and documenting functional requirements.

3.2.1 UI identification

Table 3.1 UI Identification

ID	User Interface	Actor	Purpose	Action/Feature	Expected Outcome
UID_01	Home	All actors	Central Navigation hub	Display the main option	Users can easily navigate to key areas of the system
UID_02	Login	All actors except guests	Authenticate users.	Users enter Email and password then click “login”	User is successfully authenticated and

					redirected to their dashboard
UID_03	Register	All actors	Allow users to register	Users fill in details (name,password, email)	New user account is created successfully
UID_04	Product/Listing Detail	Publisher/ Author	View detailed information about a book	Display book details such as title, description, author, price, condition, and reviews	Users can clearly understand the book before purchasing or interacting
UID_05	Create/Edit	Author/ publisher	Listing Form to post a book for sale (images,price, condition, shipping)	Display a listing form to add or edit book details (title, images, price, condition, shipping).	Book listing is successfully created or updated.
UID_06	Reading screen	reader	Area where readers will read their purchased book	Display book content with page navigation (next/previous), scroll, or swipe.	User can read the book smoothly without issues.
UID_07	Purchases	reader/author	purchasing the book the reader wants to read	Browse book listings, view book details, click “buy” button to complete checkout the payment process using chapa	Book purchase is completed successfully and the purchased book appears in the user’s library and order history
UID_08	Profile—User Dashboard	Publisher, author,reader admin	Access and manage personal account information and role	Display user profile details (name, role, email), account settings, activity summary, and role-based dashboard options (e.g.,	User can view and manage their profile and access only the features relevant to their role

			specific activities	purchased books for readers, listings for authors/publishers, system controls for admin)	
UID_09	Social— Groups Feed	Reader, Author, Publisher	Participate in community groups and access shared content	Display group list and selected group feed, including posts, events, announcements	Users can view, engage with, and stay updated on group-related discussions and activities
UID_11	Social— Group Chat/ Direct Messages	Reader, Author, Publisher	Communicate with other users in real time	Enable real-time group chat and one-to-one messaging with support for attachments and book references	Messages are sent and received instantly, allowing effective communication and collaboration
UID_12	Browse Book	guest,reader	Discover and explore available books on the platform	Browse book listings and use search, filter, and sort options by title, author, category, price, or rating	Users can easily find relevant books and view their details
UID_13	Staff/Admin Panel	Admin	Administer and monitor the platform operations	Manage user accounts, book listings, disputes, content moderation actions, and view system analytics and reports	Platform operations are effectively controlled, policy compliance is enforced, and system performance is monitored

3.2.2. Business rules identification

Business rules define the constraints, validations, and policies the system must enforce to ensure consistency, protect users and the platform, comply with legal or stakeholder requirements, and provide predictable behavior for core processes (purchasing, posting, author management, moderation, etc.).

Business rules

Below are the detailed fields to include for each rule (I've filled these for the rules above—use as-is or edit):

Table 3.2: Business rules

Business Rule ID	Name	Description
BR-01	Rule Based Access	Each actor can access and perform only the actions relevant to their assigned role. (e.g authors and publishers upload book for sell
BR-02	Content Verification & Approval Rule	All books submitted by authors or publishers must be reviewed and approved by an admin before they are published or made available on the system.
BR-03	Payment to Access	A user can only access a digital book/content after the entire purchase process has been successfully completed in a single atomic transaction
BR-04	Book review rule	A user can only give one review per book.
BR-05	Violent content prevention	author's post that violates cultural norms or promotes violence will be automatically removed by administrators
BR-06	Duplicate book prevention	Authors and publishers are prohibited from creating multiple listings for the same book within the platform. Each unique book title/edition may only have one active listing at any given time
BR-7	Privacy & data minimization	Only collect, process, and retain the minimum personal data necessary to provide

		the service, for the shortest time required, and respect user privacy rights at all times.
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3.2.3. Actor identification

This section identifies the external users and systems (actors) that interact with the application, describes their responsibilities and goals, and clarifies permissions and preconditions. Defining actors helps link user goals to use cases, UI screens, and business rules.

Table 3.3 Actors of the system

Actor Name	Short Description	Key Interactions with System
Reader	Registered user who discovers, purchases, reads, and discusses books with other readers and authors.	Browses books, purchases digital copies, tracks reading progress, joins reading groups, follows authors, writes reviews, and participates in community discussions.
Author	Content creator who writes and publishes books to sell and share with readers.	Uploads books for sale, posts updates and short stories, engages with readers, views sales reports, and manages their book catalog.
Publisher	Organization that publishes and distributes books from multiple authors.	Manages book catalog, uploads books for sale, views sales analytics, promotes books, and interacts with readers.
Guest	Unauthenticated visitor exploring the platform without an account.	Browse books and categories . Must register to purchase or participate.
Administrator	System manager responsible for platform integrity and user experience.	Manages user accounts and roles, moderates content, configures system settings, monitors platform activity, and handles reports.

Chapa Payment Gateway	Ethiopian payment processing service for digital transactions (External System).	Processes payment requests, verifies transactions.
Supabase Services	Backend-as-a-Service provider handling database, auth, and storage (External System).	Manages user authentication, stores book files, provides real-time database updates, handles file storage.

3.2.4. Designing the use-case diagram

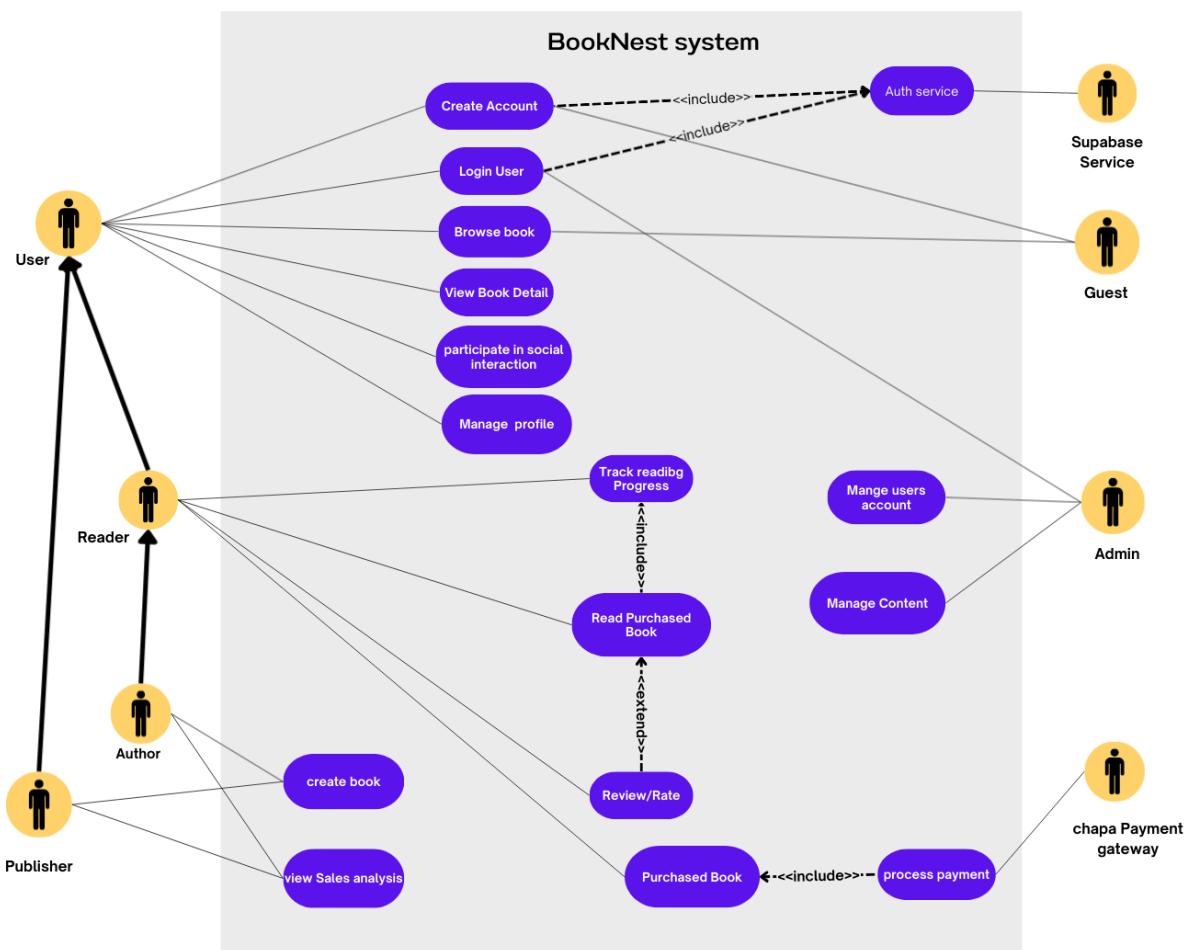


Figure 3.1 Use case diagram

3.2.5. Use case description

Table 3.4 use case: register account/sign up

Name	Register Account / Sign Up
Identifier	UC-01
Actors	Guest ,reader , publisher and author
Description	User creates a BookNest account with role selection (Reader/Author/Publisher)
Precondition	The user was not registered before.
Postcondition	A new User Account created in Supabase.
Basic course of action	<ol style="list-style-type: none"> 1. The user chooses “Register / Sign up.” 2. The user provides required details (name, email, username, password, role). 3. The system validates input and creates an account. 4. (Optional) The system sends email verification. 5. The system shows a success message and logs the user in or prompts them to verify their email.
Alternative course of action	<p>A01: Email already exists → Show error and request correction</p> <p>A02: Invalid data → Show validation errors and request correction.</p>

Table 3.5 use case: Login / User Authentication

Name	Login/User authentication
Identifier	UC-02
Actors	Reader, author, publisher and admin
Description	Authenticate user with email/password to access protected features.
Precondition	The user has a registered account.
Postcondition	The user authenticated and granted access.
Basic course of action	<ol style="list-style-type: none"> 1. The user enters email and password. 2. System validates credentials. 3. On success, the system opens the user session/dashboard.
Alternative course of action	<p>A01: Wrong credentials → Show error and request correction.</p> <p>A02: Forgot password → Trigger reset flow.</p>

Table 3.6 use case: create Book

Name	Create Book
Identifier	UC-03
Actors	Author, Publisher
Description	Author/Publisher uploads a new book with metadata and at least one format (PDF/Audio)
Precondition	User is authenticated as Author/Publisher
Postcondition	New Book created and add in to the system.

Basic course of action	<ol style="list-style-type: none"> 1. User clicks "Upload Book" 2. Enters book details 3. Adds format (PDF/Audio, price, file) 4. System validates 5. Creates book 6. Shows success
Alternative course of action	<p>A01: Invalid input → show field errors and request correction</p> <p>A02: Book already exists → deny the creation request.</p>

Table 3.7 use case: *Browse Books*

Name	Browse Books
Identifier	UC-04
Actors	Guest, Reader, Author
Description	View and filter available books in the marketplace.
Precondition	The system has book catalog data.
Postcondition	The user sees a filtered list of books matching criteria.
Basic course of action	<ol style="list-style-type: none"> 1. The user enters search keywords and/or selects filters. 2. System returns matching results sorted by relevance/filters. 3. User views results
Alternative course of action	A01: No results → Show empty state

Table 3.8 use case: View Book Details

Name	View Book Details
Identifier	UC-05
Actors	Reader, Author,, Publisher
Description	Display full metadata and actionable options for a selected book.
Precondition	The user has selected a book from the catalog.
Postcondition	The user sees book information and available actions.
Basic course of action	<ol style="list-style-type: none"> 1. User clicks book 2. The system shows metadata about the book (title, author, description, formats, price, reviews). 3. User can view details
Alternative course of action	A01: Restricted content for → prompt to purchase to view.

Table 3.9 use case: Purchase Book

Name	Purchase Book
Identifier	UC-06
Actors	Reader, author ,Chapa Payment Gateway
Description	The user buys a book , payment is processed via Chapa.
Precondition	User authenticated as Reader or author, has selected book format.
Postcondition	Payment processed, book added to user's library.
Basic course of action	<ol style="list-style-type: none"> 1. User clicks "Purchase/buy" 2. System opens Chapa payment 3. User completes payment 4. Chapa confirms 5. System adds the book to user library 6. Book accessible.
Alternative course of action	A01: Payment failed → Show retry options.

Table 3.10 use case: Process Payment

Name	Process Payment
Identifier	UC-07
Actors	Chapa Payment Gateway
Description	External payment system processes transactions and notifies BookNest.

Precondition	Payment request sent to Chapa.
Postcondition	Payment status updated.
Basic course of action	<ol style="list-style-type: none"> 1. System sends payment to Chapa 2. Chapa processes 3. System updates payment status
Alternative course of action	A01: Gateway timeout → mark order pending and show “Payment pending—processing” with reconciliation workflow.

Table 3.11 use case:Read Purchased Book

Name	Read Purchased Book
Identifier	UC-08
Actors	Reader
Description	The user opens and reads the purchased book in the reader.
Precondition	User has purchased or been granted access to the book.
Postcondition	Reading session started; progress tracked.
Basic course of action	<ol style="list-style-type: none"> 1. User selects book from library 2. System validates ownership 3. Opens PDF.js reader 4. Tracks pages read 5. Auto-saves progress
Alternative course of action	A1: Offline mode → Use cached version

Table 3.12 use case: Track Reading Progress

Name	Track Reading Progress
Identifier	UC-09
Actors	Reader, System
Description	Automatically record reading activity and update statistics
Precondition	User is reading a book
Postcondition	Progress updated in user_progress table
Basic course of action	<ol style="list-style-type: none"> 1. User reads book 2. System tracks pages/time 3. Updates progress every 30s 4. Calculates streaks 5. Updates dashboard
Alternative course of action	A1: Sync failure → Queue for retry

Table 3.13 use case: Give Review / Rate Book

Name	Give Review / Rate Book
Identifier	UC-10
Actors	Reader
Description	Submit a rating and textual review for a book; the system enforces review rules.
Precondition	The user has access to the review form

	(optional: purchased/read).
Postcondition	Review posted or queued for moderation; book rating updated.
Basic course of action	<ol style="list-style-type: none"> 1. The user opens the review form, enters the rating and text, and submits. 2. The system posts the review and recalculates the rating.
Alternative course of action	A01: Duplicate review attempt → show option to edit existing review.

Table 3.14 use case:Participate in Social Interaction

Name	Participate in Social Interaction
Identifier	UC-11
Actors	Reader, Author, publisher
Description	Post updates, comment on books, reply to others, and like or report content on the social feed.
Precondition	User is on social feed or book/community page.
Postcondition	Social content published or flagged; notifications sent as appropriate.
Basic course of action	<ol style="list-style-type: none"> 1. The user creates a post/comment and submits it. 2. The system displays the post/comment and notifies followers/interested users.

	3. Other users can like, reply, or report.
Alternative course of action	A01: Reported content → routed to moderation queue.

Table 3.15 use case: Manage Profile

Name	Manage Profile
Identifier	UC-12
Actors	Reader , Author , Admin
Description	Update personal information, credentials, and preferences in the user profile.
Precondition	User is logged in.
Postcondition	Profile updated and validated.
Basic course of action	<ol style="list-style-type: none"> 1. User opens profile settings. 2. User edits fields and saves. , 3. System validates and updates profile.
Alternative course of action	A01: Email change → trigger email re-verification. A02: Password change → require old password.

Table 3.16 use case: View Sales Analytics

Name	View Sales Analytics
Identifier	UC-13

Actors	Author, publisher
Description	Provide dashboards and reports showing sales, revenue, and trends.
Precondition	user has published books with sales data.
Postcondition	Analytics displayed and exportable.
Basic course of action	<ol style="list-style-type: none"> 1. Author opens analytics dashboard. 2. The system queries analytics data and renders charts. 3. User may filter by date or export reports.
Alternative course of action	A01: No sales data → show “no data” message.

Table 3.17 use case: Manage Users Accounts

Name	Manage Users Accounts
Identifier	UC-14
Actors	Admin
Description	View, update, or delete user accounts and roles.
Precondition	Admin authenticated.
Postcondition	User account modified.
Basic course of action	<ol style="list-style-type: none"> 1. Admin views users 2. Selects user 3. Modifies role/status 4. System updates

Alternative course of action	A01: Delete user → Confirm and cascade delete.
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Table 3.18 use case: Manage Contents

Name	Manage Contents
Identifier	UC-15
Actors	Admin
Description	Review flagged content, resolve disputes, enforce moderation policies and takedowns.
Precondition	User-generated content flagged or reported.
Postcondition	Dispute resolved and content status updated.
Basic course of action	<ol style="list-style-type: none"> 1. Admin views reports 2. Reviews evidence 3. Takes action (remove, warn, approve) 4. System logs action
Alternative course of action	A1: Appeal received → Review again

3.3. Conceptual Modeling

3.3.1. Class diagram

A class diagram shows the static structure of an object-oriented model: the object classes, their internal structure, and the relationships in which they participate. (S. Valacich and F. George).

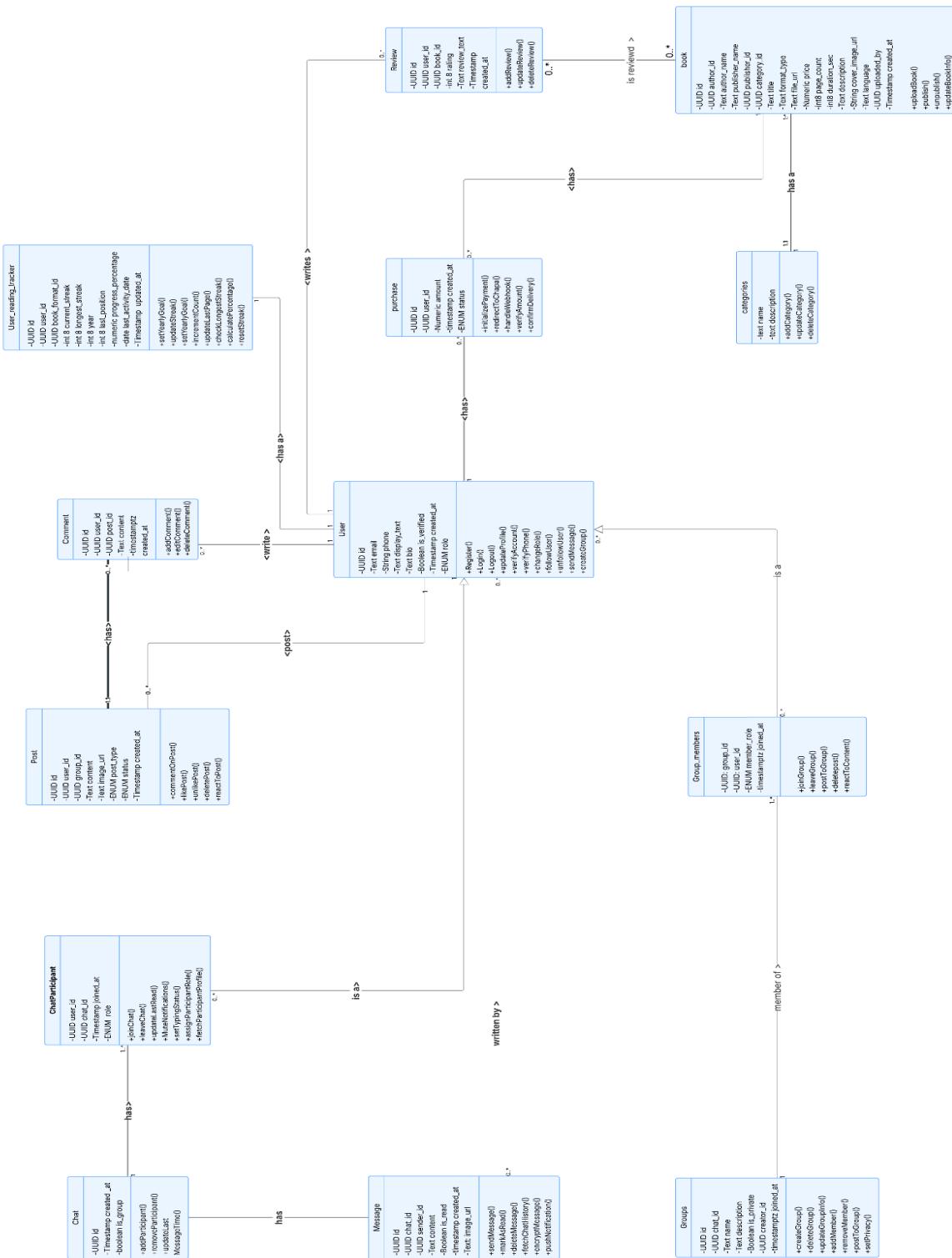


Figure 3.2 Class diagram

3.3.2 Class description

Table 3.19 Class:User

Class Name: User			
Description	The User class represents the core authentication and authorization entity of the system. It manages user identity, roles (reader, author, publisher, admin), social interactions, and system access.		
Attributes			
Attribute	Data Type	visibility	Description
id	UUID	Private	Unique identifier for the user.
email	VARCHAR(255)	Private	Email contact of the user
role	ENUM	Private	Specifies the user's role
is_verified	BOOLEAN	Private	Authors/publishers must verify to upload
created_at	TIMESTAMP	Private	Registration date
Methods			
Method	Parameters	Return Type	Description

register()	Name, email, password, phone	Boolean	Registers a new user in the system
login()	Email, password	Boolean	Authenticates the user with provided details.
logout()	userId	Boolean	Ends the user session
updateProfile()	userId, name, email, phone, profileImage	Boolean	Updates basic user information
verifyAccount()	userId	Boolean	Verifies author/publisher account
Verify Phone()	userId, verificationCode	Boolean	Verifies the user's phone number by validating the provided verification code
changeRole()	userId, role	Boolean	Changes user role (admin only)
followUser()	followerId, followingId	Boolean	Follows another user
unfollowUser()	followerId, followingId	Boolean	Unfollow a user
sendMessage()	chatId, senderId, content, image_url	Message	Sends a chat message
createGroup()	creatorId, name, description, is_private	Group	Creates a reading group

Table 3.20 Class: Book

Class name: Book			
Description		The Book class represents a digital book uploaded by authors or publishers. It handles book metadata, publishing status, reviews, and sales tracking.	
Attribute			
Attribute	Data Type	visibility	Description
id	UUID	Private	Book identifier
author_id	UUID	Private	Reference to the writer
author_name	TEXT	Private	The name of the book author
publisher_name	TEXT	Private	The name of the book publisher
publisher_id	UUID	Private	Reference to the publisher
category_id	UUID	Private	Reference to the book categories
format_type	TEXT	Private	Specifies the digital media category of the book
file_url	TEXT	Private	The web address of the actual book
price	NUMERIC	Private	Money assigned to the book

page_count	INT8	Private	Number of page for pdf book format
duration_sec	INT8	Private	Duration of the audio format of the book
title	TEXT	Private	Stores the title of the book.
description	TEXT	Private	Description of the book's content
cover_image_url	String	Private	cover image
language	TEXT	Private	Primary language
uploaded_by	UUID	Private	References the user who upload the book
created_at	TIMESTAMP	Private	Upload date
Methods			
Method	Parameters	Return Type	Description
uploadBook()	Title, price, description, genre, language, fileUrl, coverUrl, pageCount	Boolean	Uploads a new book
updateBookInfo()	Title, price, description,	Void	Updates book details

publish()	None	Void	Makes book publicly available
unpublish()	None	Void	Removes book from marketplace

Table 3.21 Class:User_reading_tracker

Class Name: User_reading_tracker			
Attribute			
Attribute	Data Type	visibility	Description
Id	UUID	Private	Unique identifier for the user reading progress record
user_id	UUID	Private	Identifies the user whose reading progress and activity are being tracked
book_format_id	UUID	Private	References the specific book format for which reading progress is recorded

current_streak	INT8	Private	Number of consecutive days the user has engaged in reading activity.
longest_streak	NUMERIC	Private	The percentage of the book completed by the user
year	INT8	Private	The calendar year associated with the reading activity and streak tracking
last_position	INT8	Private	The most recent reading position reached by the user in the book
last_activity_date	TIMESTAMP	Private	The most recent date on which the user performed a reading activity
updated_at	TIMESTAMP	Private	User The date and time when this progress record was last updated
Methods			
Method	Parameters	Return Type	Description
updateProgress()	pagesRead, totalPages	Void	Updates the user's reading progress
updatePagesRead()	pagesRead	Void	Updates pages read

calculatePercentage()	totalPages	Float	Calculates reading progress
updateStreak()	lastReadAt	Void	Updates daily reading streak
updateLastReadAt	timestamp	Void	Updates last read timestamp

Table 3.22 Class:Comment

Class Name: Comment			
Attribute			
Attribute	Data Type	Visibility	Description
id	UUID	Private	Unique identifier for the comment
user_id	UUID	Private	Identifier of the user who wrote the comment,
post_id	UUID	Private	Identifier of the post the comment is associated with
book_id	UUID	Private	Comment on book

content	TEXT	Private	The textual content of the comment.
created_at	TIMESTAMP	Private	The date and time when the comment was created
Methods			
Method	Parameters	Return Type	Description
addComment()	userId, content, postId, bookId	Comment	Creates a new comment
editComment()	Content,commet_id	Comment	Updates the content of an existing comment
deleteComment()	Comment_id	Boolean	Removes an existing comment

Table 3.23 Class:Review

Class Name: Review	
Description	The Review class allows users to rate and review books.

Attribute			
Attribute	Data Type	Visibility	Description
id	UUID	Private	Review ID
user_id	UUID	Private	Reviewer
book_id	UUID	Private	Reviewed book
rating	INTEGER	Private	Star rating
review_text	TEXT	Private	Detailed review
created_at	TIMESTAMP	Private	Review date
Methods			
Method	Parameters	Return Type	Description
addReview()	userId, bookId, content , Review	Review	Create a new review
updateReview()	content,review_id	Review	Updates existing review

deleteReview()	review_id	Boolean	Deletes review
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Table 3.24 Class: Group

Class Name: Group			
Attribute			
Attribute	Data Type	Visibility	Description
id	UUID	Private	A unique identifier for the group
chat_id	UUID	Private	Identifies the chat session associated with the group
name	TEXT	Private	The name of the group
description	TEXT	Private	Provides additional information about the group
is_private	BOOLEAN	Private	Indicates whether the group is private or public
creator_id	UUID	Private	Creator of the group

Created_at	UUID	Private	Creation date of the group
Methods			
Method	Parameters	Return Type	Description
createGroup()	name, description, isPrivate	Group	Creates a reading group
updateGroupInfo()	name, description, coverUrl	Void	Updates group details
addMember()	userId	Void	Adds member to group
removeMember()	userId	Void	Removes member
postToGroup()	postId, userId	Void	Posts content to group
setPrivacy()	isPrivate	Void	Sets group visibility

Table 3.25 Class: Group_members

Class Name: Group_members

Description		The GroupMember class represents a user's membership within a group in the system. It models the relationship between a user and a group	
Attribute			
Attribute	Data Type	Visibility	Description
group_id	UUID	Private	The unique identifier of the group that the member belongs to
user_id	UUID	Private	The unique identifier of the user who is a member of the group
member_role	ENUM	Private	The role of the member within the group.
joined_at	TIMESTAMP	Private	The timestamp indicating when the user joined the group
Methods			
Method	Parameters	Return Type	Description

joinGroup()	userId,groupId	Boolean	Adds a user to a group
leaveGroup()	userId,groupId	Boolean	Removes a user from a group
postToGroup()	UserId,postId	Boolean	Allows a member to post content
deletepost()	userId,postId	Boolean	Deletes a post in the group
reactToContent()	userId,postId,messageId	Boolean	Allows a member to react to posts and messages

Table 3.26 Class: Chat

Class Name: Chat	
Description	The Chat class manages real-time conversations between users.

Attribute			
Attribute	Data Type	visibility	Description
id	UUID	private	A unique identifier for the chat
created_at	TIMESTAMP	private	The date and time when the chat was created
is_group	BOOLEAN	private	Check if chat is a group chat or a one-on-one chat
Methods			
Method	Parameters	Return Type	Description
createChat()	type	Chat	Creates a new chat
addParticipant()	userId	Boolean	Adds participant to the chat
removeParticipant()	userId	Boolean	Removes participant form the chat
updateLastMessageTime()	timestamp	Void	Updates chat activity

Table 3.27 Class:ChatParticipant

Class Name:ChatParticipant			
Description		The ChatParticipant class manages user membership and roles within chats.	
Attribute			
Attribute	Data Type	Visibility	Description
chat_id	UUID	Private	Unique identifier of the user participating in the chat
user_id	UUID	Private	Unique identifier of the chat the user is part of
role	ENUM	Private	The role of the participant in the chat
joined_at	TIMESTAMP	Private	The date and time when the user joined the chat.
Methods			
Method	Parameters	Return Type	Description
joinChat()	chatId, userId	Boolean	Joins a chat
leaveChat()	chatId, userId	Boolean	Leaves a chat

setRole()	role	Boolean	Assigns participant role
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Table 3.28 Class:Post

Class Name: Post			
Attribute			
Attribute	Data Type	visibility	Description
id	UUID	private	Unique identifier for the post
user_id	TIMESTAMP	private	ID of the user who created the post
is_group	BOOLEAN	private	ID of the group where the post is published
content	TEXT	private	The main textual content of the post

image_url	TEXT	private	Optional URL of an image attached to the post
post_type	ENUM	private	Type of post
status	ENUM	private	The status of the post
created_at	TIMESTAMP	private	Timestamp of when the post was created
Methods			
Method	Parameters	Return	Description
commentOnPost()	userId,postId,text	comment	Allows a user to add a comment to a specific post
likePost()	userId,postId	Boolean	Allows a user to like a post
unlikePost()	userId,postId	Boolean	Allows a user to remove their like from a post
deletePost()	userId,postId	Boolean	Deletes a post
reactToPost()	userId,postId, reactiontype	Boolean	Allows a user to react to a post with an emoji or other reaction type

Table 3.29 Class:Message

Class Name: Message			
Attribute			
Attribute	Data Type	Visibility	Description
id	UUID	Private	Unique identifier for the message
chat_id	UUID	Private	Identifier of the chat where the message was sent
sender_id	UUID	Private	Identifier of the user who sent the message
content	TEXT	Private	URL or path of an image attached to the message
is_read	BOOLEAN	Private	The textual content of the message,Indicates whether the message has been read by the recipient

created_at	TIMESTAMP	Private	The date and time when the message was created
Methods			
Method	Parameters	Return Type	Description
sendMessage()	chatId, senderId, receiverId	Message	Sends a message
markAsRead()	userId, messageId	Boolean	Marks message as read
deleteMessage()	messageId	Boolean	Deletes message

Table 3.30 Class:Category

Class Name: Category			
Description		Represents a book category or genre used to organize and classify books, making it easier for users to browse, search, and filter books.	
Attribute			
Attribute	Data Type	Visibility	Description

<code>id</code>	UUID	Private	Unique identifier for the category
<code>name</code>	TEXT	Private	Name of the category
Description	TEXT	Private	Short description explaining what kind of books belong in this category
<code>created_at</code>	TIMESTAMP	Private	The date and time when the category was created
Methods			
Method	Parameters	Return Type	Description
<code>addCategory()</code>	Name,description,createdBy	Category	Creates a new category in the system

updateCategory()	CategoryId,Name,description,updatedBy	Category	Updates an existing category's information
deleteCategory()	CategoryId, deletedBy	Boolean	Deletes a category from the system after verifying user authorization

Table 3.31 Class:Purchase

Class Name: purchase			
Attribute			
Attribute	Data Type	Visibility	Description
id	UUID	Private	Unique identifier for the purchase transaction

user_id	TEXT	Private	Identifier of the user who made the purchase
amount	TEXT	Private	The total amount paid for the purchase
status	TEXT	Private	Current state of the purchase
created_at	TIMESTAMP	Private	The date and time when the category was created
Methods			
Method	Parameters	Return Type	Description
createPurchase()	userId, amount ,txRef,	Purchase	Creates a new purchase record when a user initiates a payment
confirmPurchase()	txRef	Boolean	Confirms the purchase after verifying that the payment was successfully completed
updateStatus()	PurchaseStatus	Boolean	Updates the current status of the purchase based on payment results or system actions.
cancelPurchase()	None	Boolean	Cancels a purchase that is still pending and stops further payment processing

refundPurchase()	None	Boolean	Marks the purchase as refunded after a successful refund request through the payment system
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3.4. Sequence diagramming

Sequence diagrams in the UML are primarily used to model the interactions between the actors and the objects in a system and the interactions between the objects themselves . There are UML diagrams that allow you to model interactions that include both actors and objects. It shows the sequence of interactions that take place during a particular use case or use case instance.(Sofware Enginering-Ian Sommerville)

3.4.1 Reading Progress Tracking

This diagram depicts how the system tracks reading progress automatically within the in-app reader.

Key steps:

- Reader opens book from bookshelf
- System retrieves saved progress (pages, streaks)
- System loads book in in-app viewer
- During reading session (loop):
 - Reader scrolls/interacts
 - System auto-tracks pages, time spent, percentage
 - System updates analytics (streaks, estimated finish date)
- Reader closes book/session
- System displays updated dashboard (goals, stats)
- Progress synced across devices if online

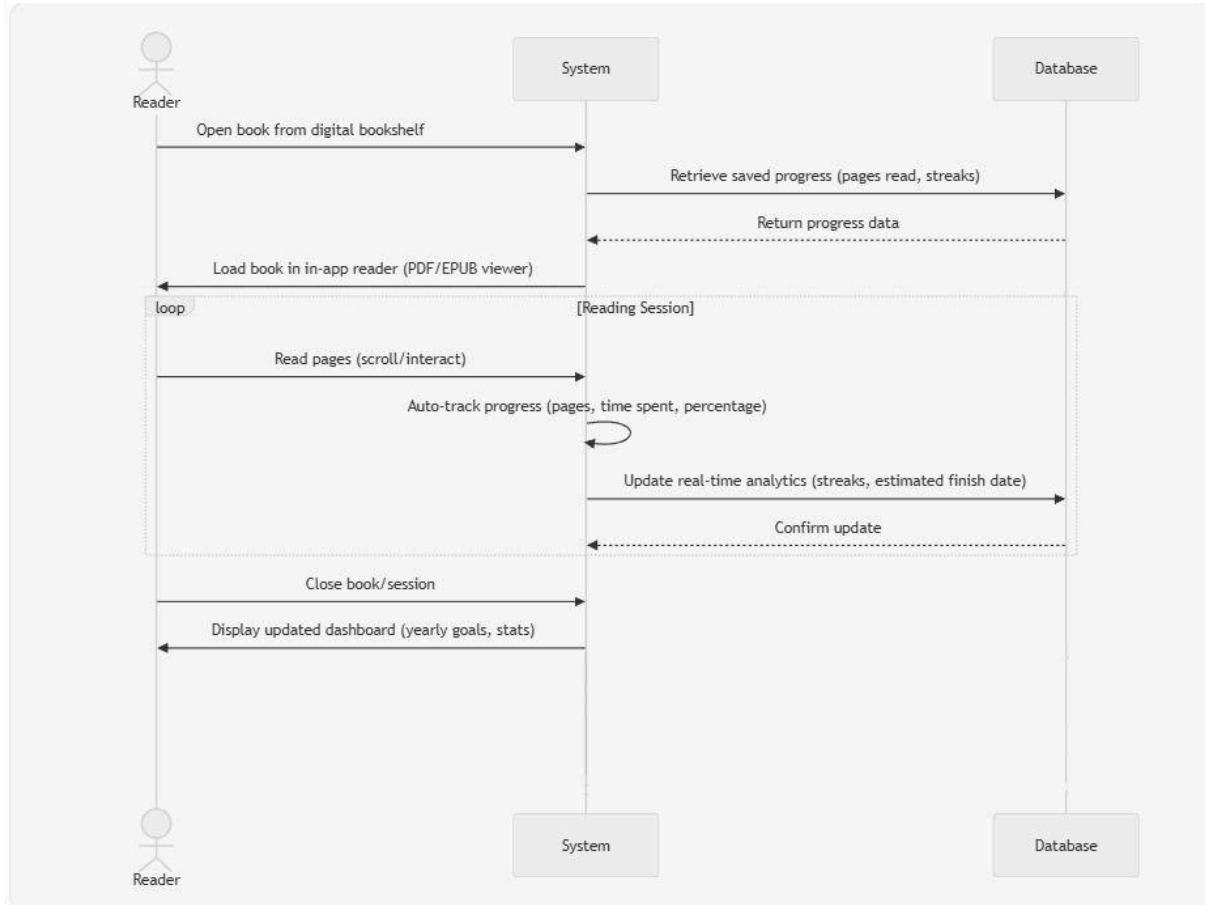


Figure 3.3: sequence diagram: Reading progress Tracking

3.4.2 General Posting Process

This diagram illustrates creating and sharing any post (e.g., discussion thread, update, or note). Posts appear in activity feeds and can trigger notifications.

Key steps:

- User navigates to post creation
- System provides form (text, images)
- User submits post
- System validates, stores post (linked to profile/book)
- System updates followers' activity feed and sends notifications
- Followers view, like, or comment (engagement loop)
- System notifies user of interactions in real time

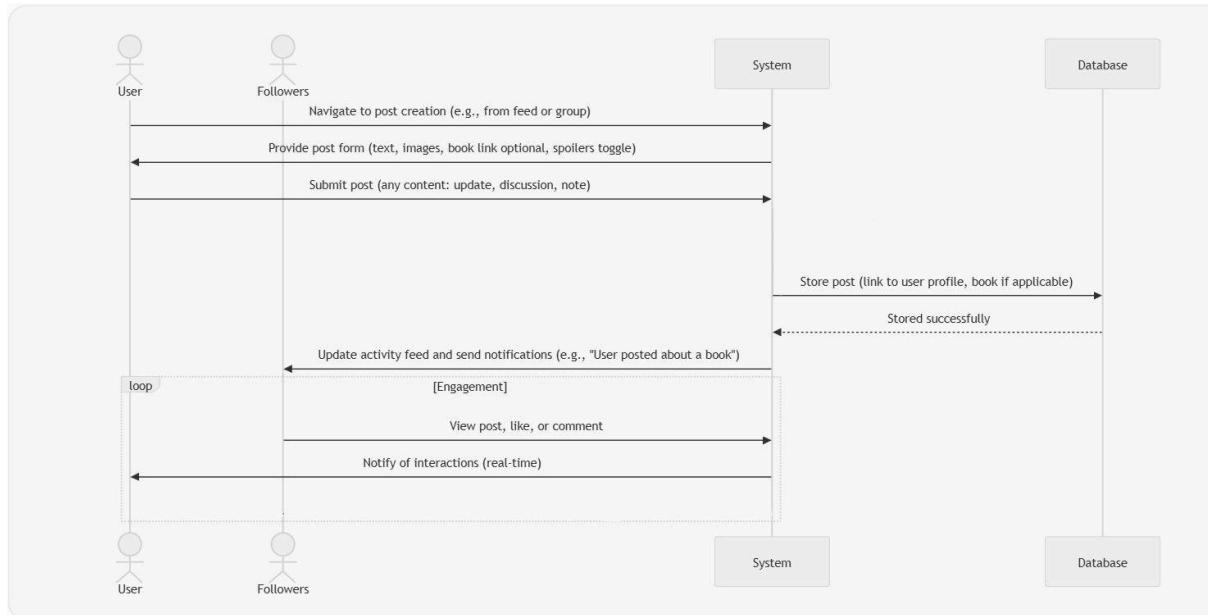


Figure 3.4: sequence diagram: General posting process

3.4.3 Following a User

This diagram shows following another user (author or reader/friend), which updates the follower's activity feed with the following user's posts, reviews, or reading updates.

Key steps:

- Follower searches or views profile
- System displays profile info (bio, shelves)
- Follower clicks “Follow” button
- System updates follow relationship in database
- Optional notification sent to FollowedUser
- Ongoing updates (posts or reading progress) pushed to Follower’s activity feed in real time

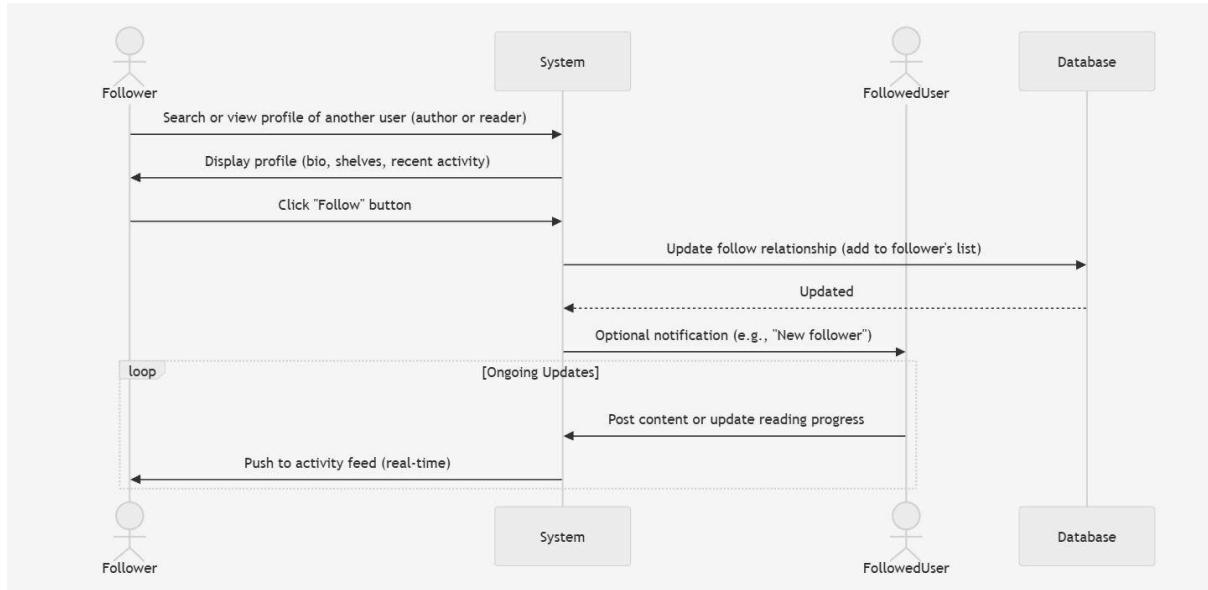


Figure 3.5: sequence diagram: Following a user

3.4.4 Direct 1:1 Chat

This diagram depicts initiating and conducting a real-time one-to-one chat between users (e.g., reader-author or reader-reader), focused on book discussions or general literary topics.

Key steps:

- UserA selects UserB (from profile, friends, or search)
- System opens chat interface (loads history if exists)
- UserA sends message (text + optional book link/emoji)
- System stores message securely
- System delivers message to UserB in real time
- Conversation continues (loop):
 - UserB replies
 - System stores and delivers reply instantly

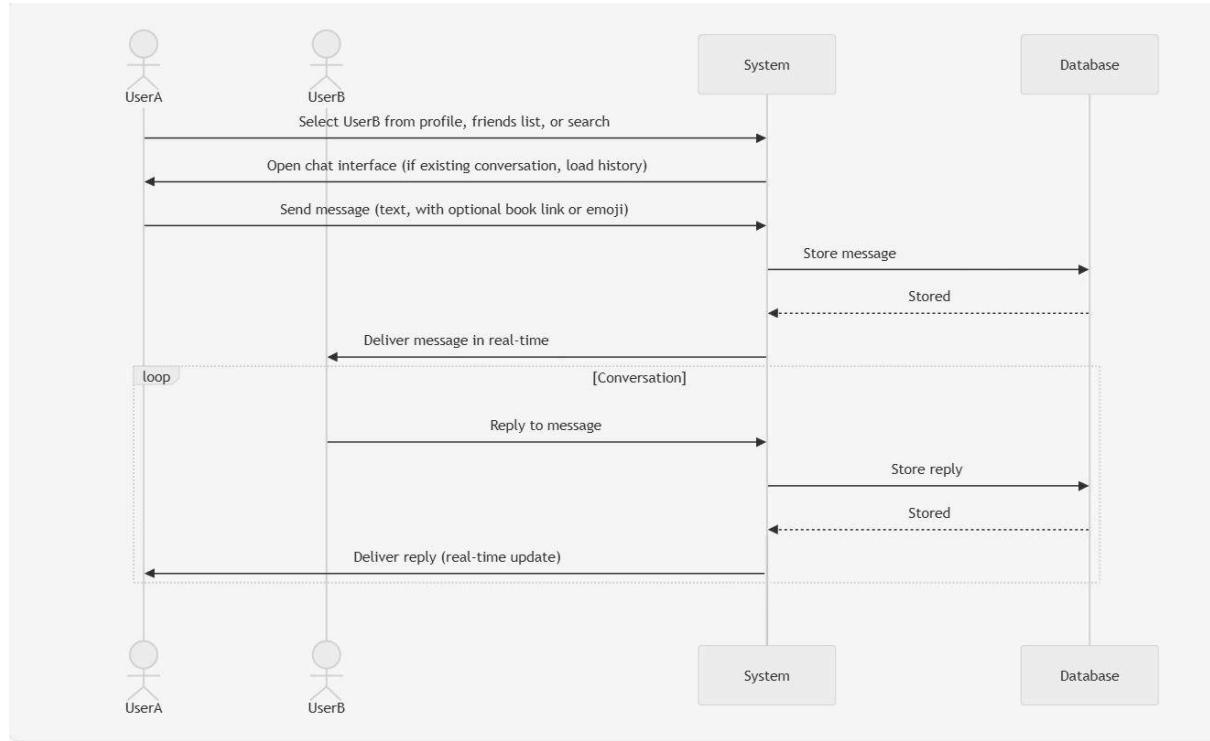


Figure 3.6: sequence diagram: Chat

3.4.5 Book Purchase Process

This diagram shows the flow for a reader purchasing a softcopy book, including payment verification via Telebirr screenshot.

Key steps:

- Reader browses / searches books
- System shows book details and “Buy” button
- Reader clicks “Buy”
- System redirects to Chapa checkout page
- Reader enters payment details and confirms
- Chapa sends webhook with success/failure status
 - If successful:
 - Instant download link provided
 - Book added to digital bookshelf
 - Sales record updated and seller notified
 - If failed/cancelled:
 - Error shown
 - Reader can retry or cancel

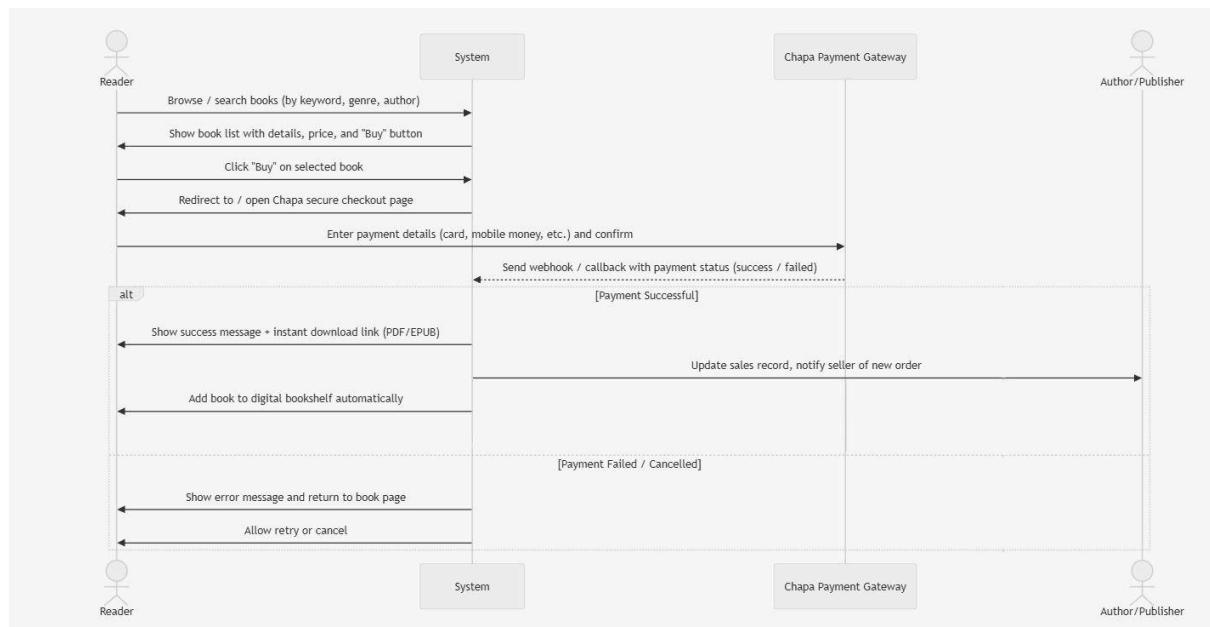


Figure 3.7: sequence diagram: Book Purchase process

3.5. User Interface Prototyping

The screenshot shows the homepage of BookNest. At the top, there is a navigation bar with the BookNest logo, a search icon, language selection (English), sign-in options, and a "Get Started" button. Below the header, a banner features the text "Over 10,000 books available" and a large, bold title "Your Digital Reading Sanctuary". A sub-copy below the title reads: "Discover, read, and grow with BookNest. An academic-grade platform for digital books, audiobooks, and personalized learning journeys. Track your progress, connect with authors, and join a community of lifelong learners." Below the title are two main buttons: "Start Reading Free" and "Browse Library". Underneath these buttons are three circular icons labeled "PDF & eBooks", "Audiobooks", and "Progress Tracking". The main content area is titled "FEATURES" and contains four sections: "Digital Books & PDFs", "Reading Streaks", "Community & Social", and "Progress Analytics". Each section has a brief description and a small icon above it. Below the features section is a testimonial header "TESTIMONIALS" followed by the heading "Loved by readers worldwide". Three testimonial cards are displayed, each with a star rating, a quote, and a photo of the reviewer. The first testimonial is from Sarah Chen, a Graduate Student, who says: "BookNest transformed my reading habits. The progress tracking keeps me motivated, and the clean interface makes reading a joy." The second testimonial is from Dr. Michael Osei, a Published Author, who says: "As an author, I love how easy it is to publish and connect with readers. The analytics help me understand what resonates with my audience." The third testimonial is from Emma Tadevos, a Busy Professional, who says: "The audiobook player is exceptional. I can switch between reading and listening seamlessly, and it always remembers where I left off."

Over 10,000 books available

Your Digital Reading Sanctuary

Discover, read, and grow with BookNest. An academic-grade platform for digital books, audiobooks, and personalized learning journeys. Track your progress, connect with authors, and join a community of lifelong learners.

[Start Reading Free](#) [Browse Library](#)

[PDF & eBooks](#)

[Audiobooks](#)

[Progress Tracking](#)

FEATURES

Everything you need for a complete reading experience

A thoughtfully designed platform that puts your learning first.

Digital Books & PDFs	Reading Streaks	Community & Social	Progress Analytics
Read beautifully-formatted PDFs with a distraction-free reader. Bookmark, highlight, and take notes.	Build consistent reading habits with daily streaks. Stay motivated and achieve your learning goals.	Connect with fellow readers and authors. Share reviews, discuss books, and grow together.	Detailed insights into your reading habits. Weekly and monthly statistics to track your growth.

TESTIMONIALS

Loved by readers worldwide

★★★★★

"BookNest transformed my reading habits. The progress tracking keeps me motivated, and the clean interface makes reading a joy."

Sarah Chen
Graduate Student

★★★★★

"As an author, I love how easy it is to publish and connect with readers. The analytics help me understand what resonates with my audience."

Dr. Michael Osei
Published Author

★★★★★

"The audiobook player is exceptional. I can switch between reading and listening seamlessly, and it always remembers where I left off."

Emma Tadevos
Busy Professional

Figure 3.8 Home page

The screenshot shows the BookNest website's home page. At the top, there is a navigation bar with the BookNest logo, a search icon, and links for "Browse", "English", "Sign in", and "Get Started". Below the navigation bar, the title "Browse Books" is displayed, followed by the subtitle "Discover your next great read from our curated collection". There is a search bar with placeholder text "Search by title, author, or keyword...", and dropdown menus for "All Categories", "All Languages", and "Sort: Most Popular". A "Grid View" button is also present. Below these controls, it says "Showing 7 books". The main content area displays seven book cards in two rows. The first row contains five books: "The Shadow King" by Maaza Mengiste, "The Beautiful Thing That Heaven Bears" by Dinaw Mengestu, "Cutting for Stone" by Abraham Verghese, "Beneath the Lion's Gaze" by Maaza Mengiste, and "Notes from the Hyena's Belly" by Nega Mezlekia. The second row contains two books: "My Name Is Why" by Lemn Sissay and "The Autobiography of Haile Selassie I: King of Kings of Ethiopia" by Haile Selassie I. Each book card includes the book title, author, a star rating, and two price options (\$18.99 and \$18.99 for most books, except \$11.99 for Beneath the Lion's Gaze). At the bottom of the page, there is a navigation bar with buttons for "Previous", "1", "2", "3", "...", "12", and "Next".

Figure 3.9 Browse Book

Create your account

Account & purpose

Email *

you@example.com

Password *

At least 6 characters

Display name *

How we'll call you

What brings you to BookNest today?



I want to read and discover books



I want to share or sell my books

Next

Already have an account? [Sign in](#)

Create your account

Your role



I am an



Author — I write and create books



Publisher — I publish and distribute books

This choice cannot be easily changed later.

Back

Create my reader account

Already have an account? [Sign in](#)

Figure 3.10 Sign-up

Welcome back

Sign in to your BookNest account

Email

you@example.com

Password

.....



Remember me

Sign in

[Forgot password?](#)

Don't have an account? [Join now](#)

Figure 3.11 log-in

BookNest

Browse English Sign in Get Started

Back to Browse

History

The Autobiography of Emperor Haile Selassie I

Haile Selassie I ★★★★ 4 (124 reviews)

PDF Available

Description About Author Reviews (124)

The autobiography recounts the life and reign of Emperor Haile Selassie I, his leadership, and Ethiopia's modern history.

Key Takeaways

- ✓ Small habits compound into remarkable results over time
- ✓ Focus on systems rather than goals
- ✓ The 4 laws of behavior change: make it obvious, attractive, easy, and satisfying
- ✓ Identity-based habits are more effective than outcome-based habits

Select Format

<input type="checkbox"/> PDF \$8.99	<input type="checkbox"/> Audiobook \$0
-------------------------------------	--

Purchase PDF - \$8.99

Save Preview

Details

Published	ISBN
-----------	------

Pages 512
Audio Duration
Language Amharic
Publisher

Figure 3.12 book detail

X አቶዕክ ሌማት ነው
አዲም ሽቦ

Contents Bookmarks Notes

■ Page 8
 ወጥ ፊይም ብሔር ሂሳብ ተተክለዋል..... ዓይነው
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«የወጪ የአዎች የአዎች የአዎች» አዎሳት

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1 Previous Page 113 of 321 35% Next >

Figure 3:13 reading area

BookNest

Home

My Library

Browse

Progress

Messages

7 Day Streak!
Keep reading to maintain your streak.

Welcome back, John

Here's what's happening with your reading today.

Total Books: 12 Completed

Current Streak: 7 Days

Reading Time: 289 Minutes this week

Best Month: Dec 2024 1,330 pages

Continue Reading

Achievements

View all

View all

7-Day Streak
Read every day for a week
Earned Dec 28, 2024

Bookworm
Complete 10 books
Earned Dec 15, 2024

Critic
Write 25 book reviews
60% complete

John Reader Reader

Figure 3.14: reader dash-board

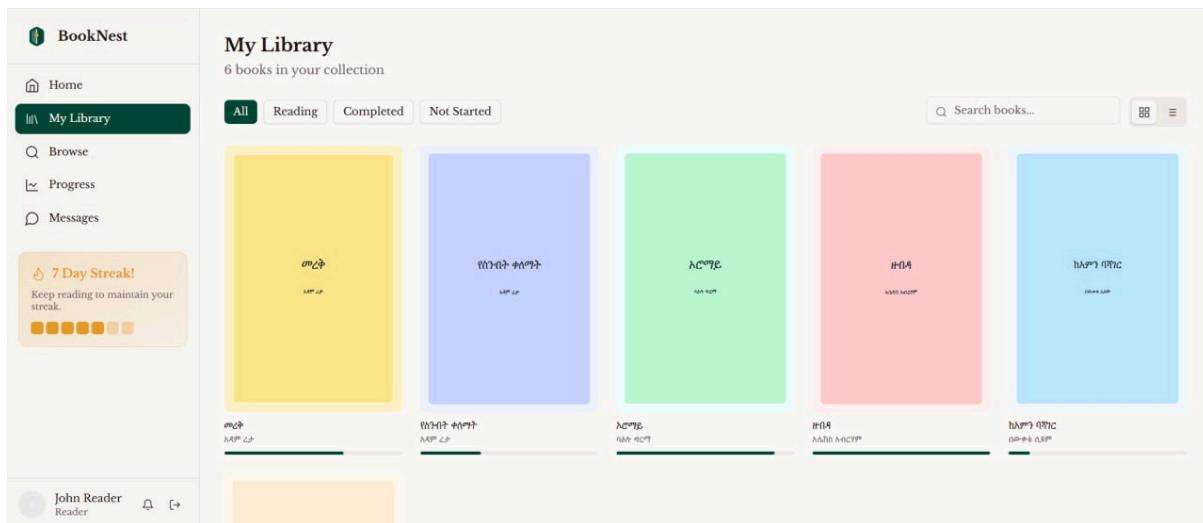


Figure 3.15 reader's book library

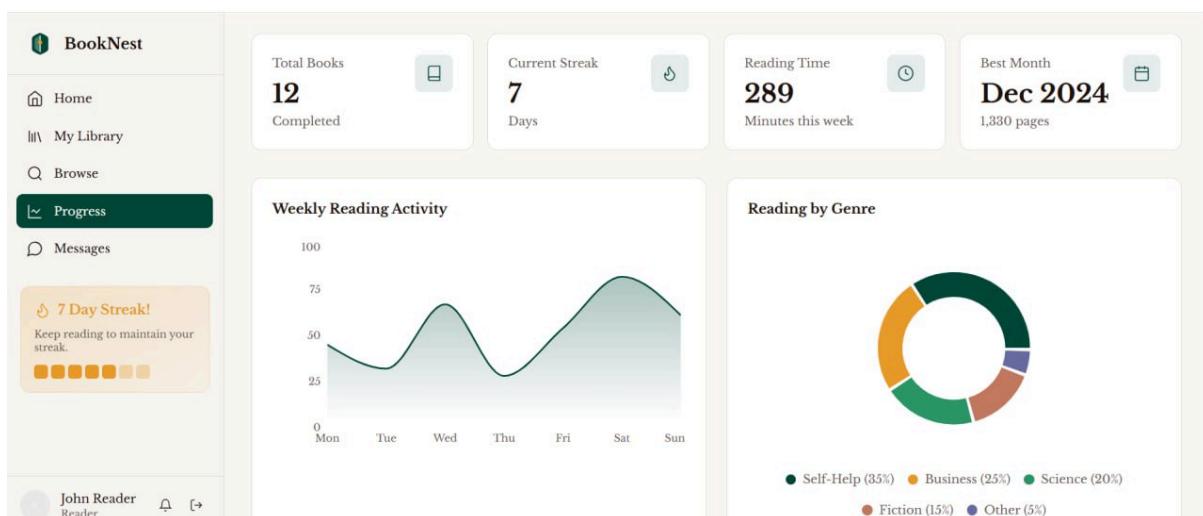


Figure 3.16 reading progress

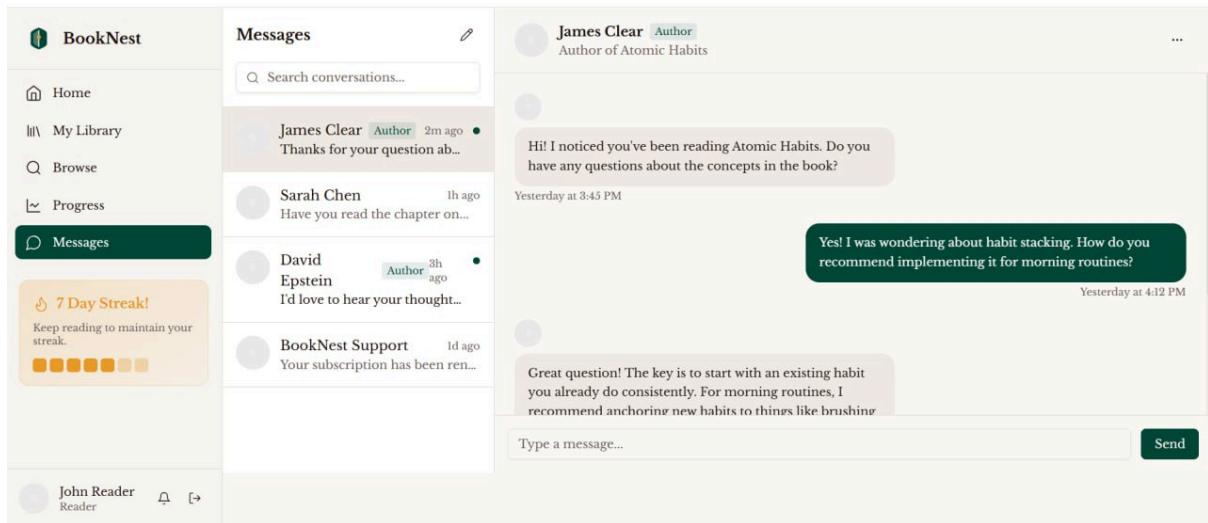


Figure 3.17 group chat/direct message for reader

The screenshot shows the Author Dashboard. On the left, there's a sidebar with navigation links: Dashboard (highlighted), My Books, Upload, Analytics, Earnings, Reviews, and Messages. Below these is a user profile for James Clear.

The main area is titled 'Author Dashboard' and includes the following sections:

- Welcome back, here's your publishing overview**
- Recent Activity** (Latest updates from your books):
 - New sale: The Art of Focus (2 min ago \$14.99)
 - New 5-star review on Mindful Living (1 hour ago)
 - New sale: Digital Minimalism Guide (3 hours ago \$9.99)
- Top Performing Books** (Your best sellers this month):

Rank	Book Title	Sales	Avg. Rating
#1	The Art of Focus	1284 sales	4.8
#2	Mindful Living	892 sales	4.6
#3	Digital Minimalism Guide	654 sales	4.5

Figure 3.18 Author and publisher dashboard

My Books

Manage your published and upcoming books

+ Upload New Book

Book	Status	Formats	Sales	Revenue	Rating
Atomic Habits Published Oct 16, 2018	Published	PDF, Audio	2,847	\$42,705	4.8 (2847)
Clear Thinking (Coming Soon)	Draft	PDF	0	\$0	—
The Habits Academy Workbook	Pending	PDF	0	\$0	—
Transform Your Habits Guide Published Mar 5, 2022	Published	PDF, Audio	1,234	\$18,510	4.6 (892)

James Clear Author [+] ...

Figure 3.19 Author's book

Upload New Book

Fill in the details to publish your book on BookNest

1 Basic Info 2 Upload Files 3 Pricing 4 Review

Book Title *

Subtitle

Description *

Category *

Select category

Language *

English

Previous Next

James Clear Author [+] ...

Figure 3.20 book upload page

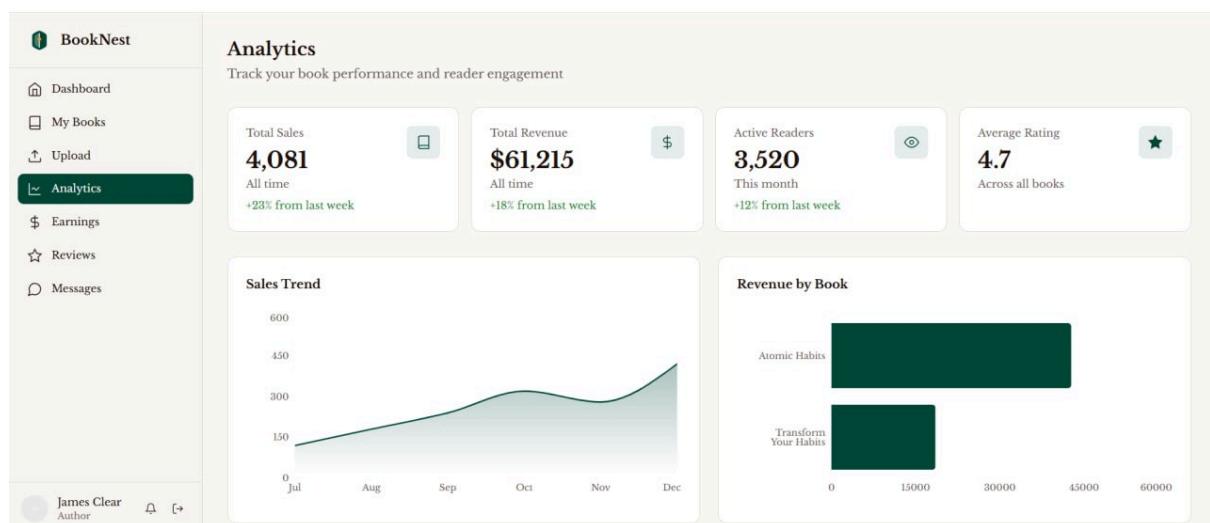


Figure 3.21 Author's Analytics page

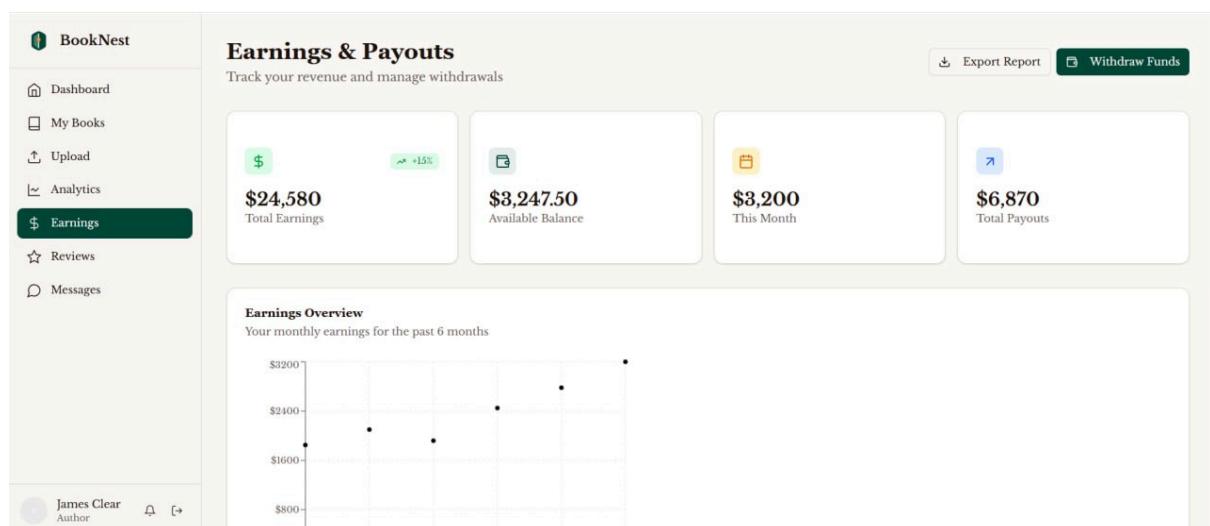


Figure 3.22 Earning and payout page

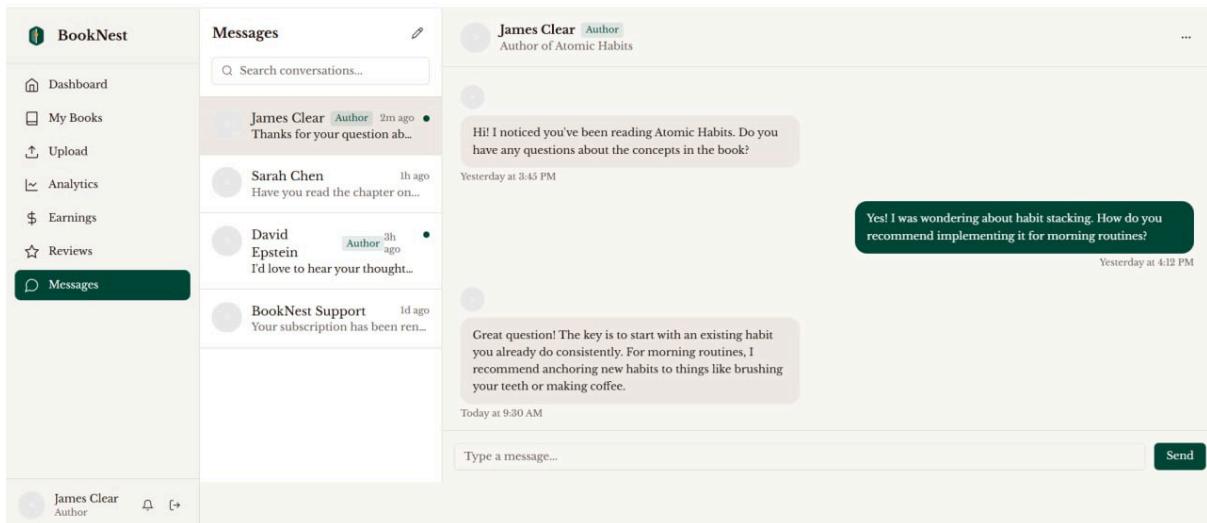


Figure 3.23 group chat/direct message for Authors

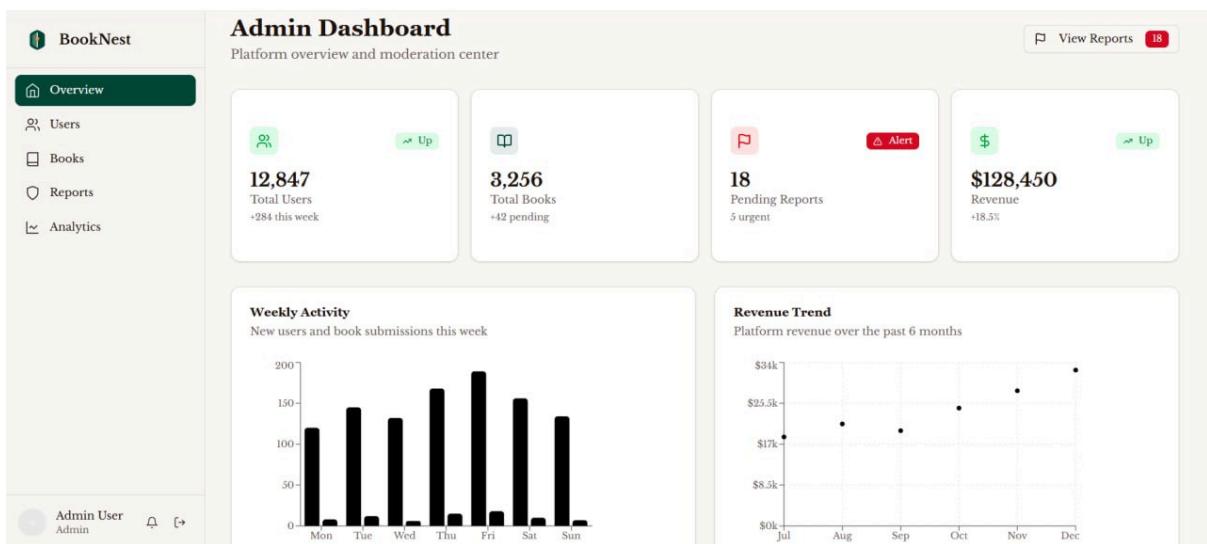


Figure 3.24 admin dash-board

User Management
View and moderate user accounts

Total Users: 12,847 | **New This Week:** 284 | **Authors:** 1,246 | **Suspended:** 23

Search users by name or email... | All Roles | All Status

Users
Showing 6 of 6 users

User	Role	Status	Joined	Books	Actions
Sarah Mitchell sarah.m@email.com	reader	active	Dec 15, 2025	24	⋮
David Kim david.k@email.com	author	pending	Dec 28, 2025	3	⋮

Admin User Admin

Figure 3.25 admin's user management page

Book Management
Review and moderate book submissions

Total Books: 3,256 | **Pending Review:** 42 | **Published:** 3,180 | **Flagged:** 8

Search books by title or author... | All Categories

Pending Review | Published | Flagged | All Books

Pending Books
Books awaiting review and approval

Book	Author	Category	Status	Submitted	Price	Actions
Modern Philosophy	David Kim	Philosophy	pending	Dec 28, 2025	\$19.99	⋮

Admin User Admin

Figure 3.26 admin's book management page

BookNest

Reports & Moderation

Review and handle flagged content

Pending Reports: 3

Urgent: 1

Investigating: 1

Resolved: 2

Inappropriate Review Content (high pending)
Target: Review on 'The Art of Focus'
Contains offensive language and personal attacks against the author
Reported by Sarah Mitchell Dec 28, 2023

Copyright Infringement (urgent investigating)
Target: Digital Art Guide
Contains copyrighted images without proper attribution or licensing

Figure 3.27 admin's report page

BookNest

Platform Analytics

Comprehensive platform statistics and insights

Total Users: 13,847 (+12.5%)

Total Books: 3,256 (+8.2%)

Total Revenue: \$1.28M (+18.5%)

Avg. Order Value: \$39.32 (+5.3%)

User Growth: Total users and authors over time

Revenue Trend: Monthly platform revenue

Figure 3.28 admin's analytic page

conclusion

This industrial project focused on the design and development of **BookNest**, a Progressive Web Application (PWA) intended to address the limitations of the existing digital book ecosystem in Ethiopia. The study identified major challenges, including the absence of a unified digital reading platform, insecure and informal digital book distribution methods, lack of automated reading progress tracking, and fragmented literary community interactions. These issues negatively affect readers, authors, and publishers and limit the growth of a sustainable digital literary environment.

In response to these challenges, the project proposed and implemented an integrated system that combines a secure digital book marketplace, an intelligent reading progress tracking mechanism, and a structured social reading community within a single platform. The system was designed with full bilingual support for Amharic and English to ensure cultural relevance and accessibility. Modern web technologies and cloud-based services were employed to achieve scalability, reliability, and cross-platform compatibility.

A comprehensive feasibility analysis confirmed that the proposed system is technically, operationally, economically, legally, and schedule feasible within the constraints of the academic timeline. The adoption of a hybrid development methodology, integrating structured system analysis with iterative agile development, enabled effective planning, risk management, and progressive system implementation. Clear project scope definition, well-structured deliverables, and systematic documentation further ensured successful project execution.

In conclusion, the BookNest platform provides a viable and practical solution to the identified problems in the Ethiopian digital reading and publishing landscape. The system has the potential to enhance access to Ethiopian literature, support authors and publishers through legitimate digital distribution, and promote active reading habits and community engagement. The successful completion of this project demonstrates that an integrated, locally tailored digital platform can contribute meaningfully to the advancement of digital literacy and cultural preservation in Ethiopia, while also providing a solid foundation for future expansion and real-world deployment.

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8. Valacich, S. and George, F.: Credited for the definition of a class diagram as a representation of a system's static structure.

APPENDIX

Form and Report

Book Delivery Order	
አዲስ አበባ ወ-ሰኑ ከሆነ መጽሐፍን በ 1 ፊመትና ገዢ ወ-ሰኑ ከነ የጋዢ እና የተዘጋጀ ነገሮች እና ተጨማሪ አገልግሎቶች!	
Please fill your information	
Your Name	<input type="text"/>
Book Title	<input type="text"/>
Book Author	<input type="text"/>
Specific Address	<input type="text"/> Your specific area please
Phone:	<input type="text"/> ፳፻፲፭
ተስማይውን ለመለከ እኔሁ ይመለክ	

Ethio Book Review delivery form

Payment Confirmation

X

አብዕም ለዚህ መጽሑፍ ከፍጥ ፈጻማው ካሆን በቋር የከፈለጊትን መንገድ ይዘገናኝ
አባርተርን መጽሑፍን እንስትራይል ስት፡ ለማንኛውም ሁሳዊ አሰተያየት ወደም
ጥቅ በ 0919ዥ ልደወላልን ይችላሉ!

እባ ይበሉ! ይህ ደርግ የሚያገለዋው አንቀጽ ለተከራል ከፍጥ በቋር ነው!
አንቀጽ ከከፈለ ለሰነድ አረጋ ወደፊው መዝግበው ይለቻልዋል!

ቦታን መልክ ከፈለ

Commercial Bank of Ethiopia (CBE)

ስልክ ቅጽር

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