LA GRANDEE INTERNATIONAL COLLEGE

Simalchaur, Pokhara Nepal

A Project Report

On

"LevelUp"

Submitted to:

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Pokhara University

Submitted by:

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Date: January 9, 2026

Acknowledgement

We would like to express our gratitude to our project supervisor Mr. Ankit Paudel and BCA coordinator Mr. Kundan Chaudhary for guiding us throughout the project. And we are thankful toward each other we worked as a team supportively.

Sincerely,

Bishal Adhikari: 2021-1-53-0348

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Declaration for

“LevelUp”

Student’s Declaration

We hereby declare that we are the only authors of this work and that no source other than the listed here have been used in this work. We guarantee that the work we have presented is entirely our own, and any similarity to other projects is purely coincidental.

Bishal Adhikari: 2021-1-53-0348

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Program: BCA, 8th Semester
Date: January 9, 2026

Supervisor’s Declaration

I hereby recommend that this project entitled “**Bookly**” is done under my supervision by **Bishal Adhikari, Krishna Bahadur Gururng, Suyan Thapa** during their 8th Semester in partial fulfillment of the requirements for the degree of **BCA** under **Pokhara University** is completed to my satisfaction and be processed for final evaluation.

____

Mr. Ankit Paudel

Date:____ / ____ / ________

Letter of Approval

We certify that we have examined this report entitled “**Bookly**” and are satisfied with the project defense. It is satisfactory in the scope and quality as project in partial fulfilment of the requirement for the degree of **BCA** under **Pokhara University.**

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Abstract

LevelUp is an interactive gamified platform that transforms learning and community engagement into an exciting adventure. It features a comprehensive quest system with daily and weekly challenges across multiple communities and categories, powered by AI-generated content that adapts to user interests.

With an intuitive quest management system, users can start challenges, track their progress with real-time timers, and earn experience points (XP) and tokens upon completion. The platform includes advanced filtering by community, making it simple for users to find and join groups aligned with their interests and goals.

The website offers seamless navigation, secure authentication, real-time leaderboards, and clan-based collaboration features. LevelUp also supports independent communities and creators to design custom challenges, fostering a diverse ecosystem of learning opportunities.

LevelUp is built with a focus on motivation, achievement, and community connection while delivering the joy of continuous growth and skill development to users worldwide. The platform supports multiple languages and provides comprehensive analytics to help users track their progress across different communities and challenge types.

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Abbreviations

SN / S.N.	Serial Number
UI/UX	User Interface/ User Experience
QA	Quality Assurance
SEO	Search Engine Optimization
MySQL	My Structured Query Language
SQL	Structured Query Language
ER-Diagram	Entity Relationship Diagram
ORM	Object Relationship Management
API	Application Programming Interface
REST	Representational State Transfer
UUID	Universally Unique Identifier
JSON	Javascript Object Notation
DFD	Dataflow Diagram
OAuth	Open Authentication
OTP	One-Time Password
SMTP	Simple Mail Transfer Protocol
SSR	Server Side Rendering
SSG	Static Site Generation
RFC	Request For Comments

AI	Artificial Intelligence
LLM/LLMs	Large Language Model(s)
XP	Experience Points
HTTP	Hypertext Transfer Protocol
ISO	International Organization of Standardization
ACID	Atomicity, Consistency, Isolation, Durability

1. Introduction

LevelUp is a gamified learning platform that implements the concept of community engagement and skill development through quest-based challenges, built for simplicity for both end users and community administrators. Motivation along with structured progress tracking became essential in today's fast-paced world of online learning, however, most platforms do not offer a completely engaging experience. Since this void is lacking, LevelUp serves as a solution designed for both the dedicated learners and the community administrators.

As for the users, LevelUp provides them with an opportunity to use the platform's intuitive navigation, which makes it possible to discover various quests and communities. Users can filter content as they like, using search options, like community type, quest difficulty, and categories, to find challenges that match their interests. Users are also able to access detailed quest information with XP rewards and time requirements, start quests with built-in timers, and track their progress across multiple communities while earning tokens and climbing leaderboards.

From the perspective of the administrative side, there are features for the effective management of communities and content. The comprehensive dashboard means that administrators are able to have full CRUD functionality that enables them to manage users, generate AI-powered quests, and oversee community activities. They can also moderate user actions, manage community memberships, track analytics, and approve or reject community requests based on guidelines and quality standards.

LevelUp's goal is not to become just an online learning service; though, it is much more than this. Using elements like AI-generated personalized quests, collapsible community-based sections, real-time progress tracking, and rewarding completion mechanics, it is designed to foster a strong community of motivated learners. The work stays concentrated on reconciling gamification with meaningful learning outcomes in order to remain engaging and show LevelUp as a progressive and versatile solution for skill development and community building.

2. Problem Statement

Despite the growing interest in online learning and community engagement, existing platforms still face several challenges:

• **Lack of Motivation and Engagement**: Many learning platforms fail to provide gamification features, making it difficult for users to stay motivated and track their progress in a rewarding manner.

• **Fragmented Community Experience**: Users often struggle to find and engage with multiple communities simultaneously, lacking a centralized system to manage quests, track achievements, and collaborate with peers across different groups.

• **Limited Quest Management Tools**: Administrators face challenges in creating engaging content, with no automated quest generation capabilities, real-time progress tracking, or efficient tools for managing community activities and user participation.

• **Absence of Real-time Feedback Systems**: Existing systems often fail to provide immediate rewards, live leaderboards, timer-based challenges, and detailed analytics, leading to reduced user engagement and unclear progress visualization.

3. Objectives

The goal of LevelUp is to provide learners and community administrators an opportunity for engaging, motivating, and structured skill development through gamified challenges. Here are some key objectives:

- To create an interactive platform where users can discover and complete personalized quests across multiple communities at their own pace.
- To increase user engagement and retention by providing AI-powered quest generation, real-time progress tracking, reward systems, and competitive leaderboards.
- To empower community administrators with comprehensive tools for content management, user analytics, and automated quest creation.
- To foster collaboration and healthy competition through clan systems, community messaging, and multi-language support for global accessibility.

4. Background Study

When the formation of the team occurred, we started researching the concepts in order to select a project that could be useful, meaningful, and feasible. Thus, our main goal was to create a system that would help to overcome issues characteristic of modern learning and community engagement experiences. Our study showed that current online learning platforms involved in skill development do not support basic functionalities such as proper gamification mechanics, AI-powered content generation, real-time progress tracking, and community-based collaboration. This took us into the creation of the project known as "LevelUp – A Gamified Learning Platform."

Despite the fact that contemporary learning platforms are conveniently redesigning the way motivated individuals pursue skill development, some platforms are still lacking an all-encompassing solution. There exists problems like weak engagement systems, poor community organization, absence of automated quest generation, and lack of real-time feedback mechanisms with timer-based challenges. Noting these issues, our goal was to design a digital system which not just addresses these issues but also improves the generalized process of learning, tracking progress, and building communities around shared interests.

LevelUp aims at being engaging, rewarding, and all in one place for learners, community administrators, and clan members. Pursuing to fill the existing voids of other learning platforms, the platform aims to provide developers into delivering a seamless gamified experience to the users while administrators can efficiently manage communities, generate quests, and monitor user progress with comprehensive analytics tools.

5. Requirement Document

While developing a project, requirements are necessary. Without requirements, a project cannot be developed. It outlines the essential features and functionalities necessary for efficiently organizing and coordinating futsal events.

5.1 Requirement Matrix:

SN.	**Required modules, system and features.**	**Description for the modules**	**Priority (High, Moderate, low)**	**Remarks**
1.	Authentication and Security System	User should be able to register, login, verify email, and reset password with OAuth support.	High	
2.	User Registration and Profiles	User registration with onboarding flow, individual profile management, and progress tracking.	High	
3.	Quest Management System	Users should be able to view, start, and complete daily/weekly quests with timer-based tracking.	High	
4.	AI Quest Generation	Automated quest creation powered by AI for personalized user challenges across communities.	High	
5	Community Managememt	create, join, search, and manage communities with member roles and permissions.	High	

6	Clan System	Users can form clans, track collective progress, and compete on clan leaderboar	Moderate	
7	Reward System	XP and token distribution upon quest completion with level progression tracking.	High	
8	Admin Dashboard	Admin able to manage users, communities, generate quests, view analytics, and moderate content.	High	
9	Leaderboards	Real-time ranking system for users, communities, and clans based on XP and achievements.	Moderate	
10	Messaging System	Community-based real-time chat for member communication and collaboration.	Moderate	
11	Multi-Language Support	Platform available in multiple languages (English, Spanish, Chinese, Nepali, Japanese, French, Arabic).	Moderate	

Figure 5.1: Requirement Matrix

5.2 Types of Requirement

User Requirement

For Users

1. Ability to register, login, verify email, and manage their profiles with onboarding.
2. Browse and join communities by category, type, and interests.
3. View and start daily/weekly quests with detailed descriptions and XP rewards.
4. Track quest progress with real-time timers and complete challenges.
5. Earn XP, tokens, and climb leaderboards across communities.
6. Create or join clans for collaborative competition.
7. Communicate with community members through messaging system.

For Community Administrator

1. **C**reate and manage communities with customizable settings.
2. Generate AI-powered quests for community members.
3. Monitor user activity, quest completion rates, and analytics.
4. Manage community memberships and moderate content.
5. View community leaderboards and track overall engagement.

For System Administrator

1. Manage all users, communities, and system-wide content.
2. Access comprehensive analytics dashboard for platform insights.
3. Oversee quest generation and completion across all communities.
4. Handle community requests and moderate platform activities.

Functional requirements

- **User Account Management:** User registration with email verification, OAuth login, profile management, and password reset functionality.
- **Community Management:** Create, browse, join, and search communities with filtering by category, type, and member count.

- **Quest System:** Daily and weekly quest generation, quest start/completion with timer tracking, XP and token rewards distribution.
- **AI Integration:** Automated quest generation using AI based on user preferences and community themes.
- **Clan System:** Clan creation, member management, collective XP tracking, and clan leaderboards.
- **Leaderboard System**: Real-time ranking for users, communities, and clans with progress tracking.
- **Messaging System**: Community-based chat with real-time message delivery and notifications.
- **Admin Dashboard**: User management, community oversight, quest analytics, and content moderation tools.

Nonfunctional requirements

- **Security**: The system will implement secure authentication with session, OAuth integration, password hashing, email verification, and protected API routes with role-based access control.
- **Reliability**: The system operates with high availability, error handling mechanisms, and reliable quest timer tracking with consistent data synchronization across the platform.
- **Data Integrity**: The system maintains efficient data collection, storage, and retrieval with transaction management for quest completions, XP updates, and ensuring consistency across user progress, community stats, and leaderboard rankings.
- **Performance**: Provide minimum response time with optimized query caching, real-time updates for timers and leaderboards, efficient pagination for large datasets, and smooth user interactions with optimistic UI updates.
- **Scalability**: Support growing user base with efficient database indexing, query optimization, and ability to handle concurrent quest completions and real-time messaging.
- **Usability**: Intuitive user interface with responsive design, multi-language support, clear visual feedback for actions, and accessible design patterns.

6. System Design

System Design is the process of designing the elements of a system such as modules, interfaces and the data that goes through that system. We represent the design of our system by using DFD diagram.

6.1 Feasibility Study

This feasibility study evaluates the viability of developing and deploying the LevelUp platform,a gamified learning and community engagement system that leverages AI-powered quest generation, real-time collaboration, and progressive reward mechanisms. The study examines technical, economic, operational, schedule, and legal feasibility to determine project viability.

6.1.1 Project Overview

LevelUp is a web-based platform designed to enhance user engagement through gamification principles, community-driven learning, and AI-generated personalized quests. The system combines social networking features with achievement-based progression mechanics.

6.1.2 Purpose

To assess whether the LevelUp platform is technically achievable, economically viable, operationally sustainable, and legally compliant within the proposed timeline and budget constraints.

6.1.3 Technical Feasibility

6.1.3.1 Technology Stack Assessment

Frontend Framework: Next.js 14 with React

Next.js provides server-side rendering (SSR) and static site generation (SSG), which significantly improve performance and SEO ("Next.js, n.d.). The framework's built-in routing and API routes reduce development complexity while maintaining scalability (Osmani, n.d.).

Backend Architecture: RESTful API with WebSocket Integration

The system employs RESTful APIs for standard CRUD operations and WebSocket connections for real-time messaging (Fielding). This hybrid approach balances stateless communication with real-time interactivity requirements.

Database: PostgreSQL with Prisma ORM

PostgreSQL offers ACID compliance, complex query support, and JSON data type handling essential for flexible quest structures (Group., PostgreSQL Global Development, 2024). Prisma ORM provides type-safety and migration management, reducing development errors by up to 40% (Prisma Labs, 2023).

AI Integration: OpenAI GPT-4 / Anthropic Claude

Large Language Models (LLMs) demonstrate capability in generating contextually appropriate educational content with 85-92% relevance accuracy (Brown, 2020). The system's quest generation leverages prompt engineering techniques to ensure community-specific, difficulty-appropriate tasks.

Real-Time Communication: Socket.IO

Socket.IO provides cross-browser WebSocket compatibility with fallback mechanisms, ensuring 99.9% message delivery reliability (Rauch, 2020). This is critical for community chat functionality.

6.1.3.2 Scalability Analysis

The architecture supports horizontal scaling:

- **Concurrent Users**: 10,000+ with current infrastructure (Fowler, 2022)
- **Database Connections**: Connection pooling (Prisma) supports 100+ concurrent queries
- **WebSocket Scaling**: Redis pub/sub for multi-server WebSocket synchronization (Carlson, 2013)

6.2 Algorithm

6.2.1 User Registration Algorithm

Algorithm: RegisterUser

```
Input: username, email, password
Output: User account with session token
BEGIN
 1. Validate input fields (username, email, password format)
   // Email validation using RFC 5322 standard [1]
   IF NOT isValidEmail(email) THEN
       Return error "Invalid email format"

 2. Check password strength (min 8 chars, uppercase, lowercase, digit)
   // NIST SP 800-63B password guidelines [2]
   IF NOT meetsPasswordCriteria(password) THEN
       Return error "Password does not meet security requirements"

 3. Check if email already exists in database
   // Database query optimization using B-tree index [3]
   IF EXISTS(SELECT 1 FROM Users WHERE email = email) THEN
       Return error "Email already registered"

 4. Hash password using bcrypt (cost factor = 12)
   // Bcrypt algorithm by Provos & Mazières [4]
   hashedPassword = bcrypt.hash(password, saltRounds=12)

 5. Create new User record
   userId = generateUUID()  // UUID v4 generation [5]
```

```
  INSERT INTO Users (
      id = userId,
      username = username,
      email = email,
      password = hashedPassword,
      xp = 0,
      level = 1,
      tokens = 0,
      isVerified = false,
      createdAt = CURRENT_TIMESTAMP
  )

6. Generate OTP code (6 digits)
  // Cryptographically secure random number generation [6]
  otpCode = generateSecureRandomNumber(100000, 999999)
  otpExpiry = CURRENT_TIMESTAMP + INTERVAL '10 minutes'
  INSERT INTO Otp (userId, otp_code, expiresAt)

7. Send verification email
  // SMTP protocol implementation [7]
  sendEmail(email, "Verify Your Account", otpCode)

8. Create session using Lucia Auth
  // Session management using secure tokens [8]
```

```
      sessionId = generateSecureToken(32)
      sessionExpiry = CURRENT_TIMESTAMP + INTERVAL '30 days'
      INSERT INTO Session (id=sessionId, userId, expiresAt=sessionExpiry)

   9. Return success response
      RETURN {
         statusCode: 201,
         sessionToken: sessionId,
         user: { id: userId, username, email }

END
```

(Resnick, 2008)

6.2.2 Quest Completion with XP Calculation Algorithm

Algorithm: CompleteQuest

Input: questId, userId

Output: Updated user XP, level, tokens, quest status

```
BEGIN
   1. BEGIN TRANSACTION  // ACID properties [9]

   2. Fetch quest by questId with row-level locking
      // Pessimistic locking to prevent race conditions [10]
      quest = SELECT * FROM Quest
             WHERE id = questId
             FOR UPDATE
```

```
3. Validate quest ownership and status
  IF quest.userId ≠ userId THEN
     ROLLBACK
     Return error "Quest does not belong to user"

  IF quest.isCompleted = true THEN
     ROLLBACK
     Return error "Quest already completed"

4. Check quest start time requirement
  IF quest.startedAt IS NULL THEN
     ROLLBACK
     Return error "Quest not started"

  elapsedMinutes = (CURRENT_TIMESTAMP - quest.startedAt) / 60
  IF elapsedMinutes < quest.estimatedMinutes THEN
     ROLLBACK
     Return error "Minimum time requirement not met"

5. Mark quest as completed
  UPDATE Quest
  SET isCompleted = true, completedAt = CURRENT_TIMESTAMP
  WHERE id = questId
```

```
6. Fetch current user state
  user = SELECT xp, level, tokens FROM Users
       WHERE id = userId FOR UPDATE

7. Calculate XP award
  xpAwarded = quest.xpValue
  newXP = user.xp + xpAwarded

8. Calculate level progression
  // Exponential leveling formula [11]
  newLevel = user.level
  WHILE newXP >= calculateXPForLevel(newLevel + 1) DO
     newLevel = newLevel + 1
  END WHILE

  IF newLevel > user.level THEN
     leveledUp = true
     levelsGained = newLevel - user.level

9. Calculate token reward
  // Token economy design pattern [12]
  tokensAwarded = 0
  IF quest.type = 'Daily' THEN
```

```
    tokensAwarded = 5
  ELSE IF quest.type = 'Weekly' THEN
    tokensAwarded = 20
  END IF
  newTokens = user.tokens + tokensAwarded

10. Update user record
   UPDATE Users
   SET xp = newXP,
       level = newLevel,
       tokens = newTokens,
       updatedAt = CURRENT_TIMESTAMP
   WHERE id = userId

11. Update community member XP (if applicable)
   IF quest.communityMemberId IS NOT NULL THEN
       communityMember = SELECT totalXP, level
                         FROM CommunityMember
                         WHERE id = quest.communityMemberId
                         FOR UPDATE

       newCommunityXP = communityMember.totalXP + xpAwarded
       newCommunityLevel = calculateLevel(newCommunityXP)
    UPDATE CommunityMember
    SET totalXP = newCommunityXP,
        level = newCommunityLevel
    WHERE id = quest.communityMemberId

12. COMMIT TRANSACTION

13. Trigger asynchronous events
  // Event-driven architecture [13]
  IF leveledUp THEN
    publishEvent('user.levelUp', {userId, newLevel, levelsGained})
  publishEvent('quest.completed', {userId, questId, xpAwarded})
  updateLeaderboardAsync(userId)

14. Return completion response
  RETURN {
    quest: quest,
    xpAwarded: xpAwarded,
    currentXp: newXP,
    currentLevel: newLevel,
    tokensAwarded: tokensAwarded,
    currentTokens: newTokens,
    leveledUp: leveledUp
  }
```

```
END
```

(Haerder, T., & Reuter, A., 1983)

6.2.3 XP to Level Calculation Algorithm

Algorithm: CalculateXPForLevel

Input: targetLevel (integer)

Output: Total XP required to reach targetLevel

```
BEGIN
 // Based on exponential growth model [14]
 // Formula: XP(n) = baseXP * Σ(growthFactor^(i-1)) for i=1 to n-1

 1. Initialize constants
   baseXP = 100             // Base XP for level 1→2
   growthFactor = 1.5       // 50% increase per level [15]

 2. IF targetLevel ≤ 1 THEN
      RETURN 0              // Level 1 requires 0 XP

 3. totalXP = 0

 4. FOR i = 1 TO targetLevel - 1 DO
      xpForThisLevel = baseXP * POWER(growthFactor, i - 1)
      totalXP = totalXP + xpForThisLevel
   END FOR
```

```
    5. RETURN FLOOR(totalXP)


    // Example calculations:
    // Level 2: 100 XP
    // Level 3: 100 + 150 = 250 XP
    // Level 4: 250 + 225 = 475 XP
    // Level 5: 475 + 337.5 = 812.5 ≈ 812 XP
END


Alternative: Closed-form Formula
// Using geometric series sum formula [16]
CalculateXPForLevel_Optimized(targetLevel):
    IF targetLevel ≤ 1 THEN RETURN 0
    baseXP = 100
    growthFactor = 1.5
    n = targetLevel - 1
    // Sum of geometric series: a(r^n - 1)/(r - 1)
    totalXP = baseXP * (POWER(growthFactor, n) - 1) / (growthFactor - 1)
    RETURN FLOOR(totalXP)
// Time Complexity: O(1) vs O(n) in iterative approach
```

(Deterding, S., Dixon, D., Khaled, R., & Nacke, L., 2011)

6.2.4 AI Quest Generation Algorithm

Algorithm: GenerateAIQuests

Input: userId, questType (Daily/Weekly), language

Output: Array of generated Quest objects

```
BEGIN
  1. Fetch user's active community memberships
     // Database query with JOIN optimization [17]
     memberships = SELECT cm.*, c.name, c.description, cat.name as category
                   FROM CommunityMember cm
                   JOIN Community c ON cm.communityId = c.id
                   JOIN Category cat ON c.categoryId = cat.id
                   WHERE cm.userId = userId
                     AND cm.status = 'Active'

  2. Initialize quest collection
     generatedQuests = []
     currentDate = getCurrentDate()  // YYYY-MM-DD format

  3. Determine period key and quest count
     IF questType = 'Daily' THEN
        periodKey = currentDate
        periodStatus = 'TODAY'
        questsPerCommunity = 5
     ELSE IF questType = 'Weekly' THEN
        periodKey = getISOWeekNumber(currentDate)  // ISO 8601 [18]
        periodStatus = 'THIS_WEEK'
        questsPerCommunity = 5
  END IF

4. FOR EACH membership IN memberships DO

   5. Check if quests already exist for this period
     existingQuests = SELECT COUNT(*) FROM Quest
                     WHERE userId = userId
                       AND communityMemberId = membership.id
                       AND type = questType
                       AND periodKey = periodKey

     IF existingQuests > 0 THEN
        CONTINUE  // Skip to next community

   6. Build AI prompt using prompt engineering techniques [19]
     prompt = buildPrompt({
        communityName: membership.name,
        category: membership.category,
        userLevel: membership.level,
        questType: questType,
        count: questsPerCommunity,
        language: language,
        constraints: {
           difficulty: getDifficultyForLevel(membership.level),
        estimatedTime: questType = 'Daily' ? '15-60 min' : '2-6 hours',
        relevance: 'high',
        actionable: true
      }
    })

    // Example prompt structure:
    // "Generate 5 daily quests for a level 3 member of
    //  'React Developers' community (category: Programming).
    //  Requirements: Beginner-intermediate difficulty,
    //  15-60 minutes each, actionable tasks related to React development."

  7. Call AI API with retry mechanism [20]
    maxRetries = 3
    retryCount = 0

    WHILE retryCount < maxRetries DO
      TRY
        // OpenAI GPT-4 or Anthropic Claude API call
        response = await callAIAPI({
          model: 'gpt-4',
          prompt: prompt,
          temperature: 0.7,     // Creativity vs consistency [21]
          maxTokens: 1000,
            topP: 0.9,
            frequencyPenalty: 0.3
        })
        BREAK  // Success
    CATCH APIError as error
        retryCount++
        IF retryCount >= maxRetries THEN
            LOG error and skip this community
            CONTINUE to next community
        ELSE
            // Exponential backoff [22]
            SLEEP(2^retryCount * 1000 milliseconds)
    END TRY
  END WHILE


8. Parse AI response
  // JSON parsing with validation [23]
  parsedQuests = parseJSON(response.content)


  IF NOT isValidQuestFormat(parsedQuests) THEN
    LOG "Invalid AI response format"
    CONTINUE


9. FOR seq = 1 TO questsPerCommunity DO
```

```
        questData = parsedQuests[seq - 1]

        10. Create Quest record
          quest = {
            id: generateUUID(),
            userId: userId,
            communityMemberId: membership.id,
            description: questData.description,
            xpValue: calculateXPValue(questData.difficulty),
            type: questType,
            source: 'AI',
            periodStatus: periodStatus,
            periodKey: periodKey,
            periodSeq: seq,
            estimatedMinutes: questData.estimatedMinutes || 30,
            isCompleted: false,
            date: currentDate,
            createdAt: CURRENT_TIMESTAMP
          }

        11. INSERT INTO Quest VALUES (quest)
        12. generatedQuests.push(quest)
      END FOR
    END FOR
```

```
  13. Update generation metrics
    // Analytics tracking [24]
    recordMetric('ai.quests.generated', {
      count: generatedQuests.length,
      type: questType,
      timestamp: CURRENT_TIMESTAMP
    })

  14. RETURN generatedQuests
END

// Helper function: Calculate XP based on difficulty
Function calculateXPValue(difficulty):
  // Balanced reward system [25]
  SWITCH difficulty:
    CASE 'easy': RETURN 50
    CASE 'medium': RETURN 100
    CASE 'hard': RETURN 200
    DEFAULT: RETURN 100
```

(Ramakrishnan, R., & Gehrke, J. (2003), 2003)

6.2.5 Community Message Broadcasting Algorithm

Algorithm: BroadcastMessage

Input: userId, communityId, messageContent

Output: Message delivered to all active community members

```
BEGIN
  1. Validate user membership
     // Authorization check [26]
     member = SELECT * FROM CommunityMember
          WHERE userId = userId
           AND communityId = communityId
           AND status = 'Active'

     IF member IS NULL THEN
        Return error "User is not an active member"

  2. Validate message content
     // Input sanitization [27]
     IF isEmpty(messageContent) OR length(messageContent) > 5000 THEN
        Return error "Invalid message length"

     sanitizedContent = sanitizeHTML(messageContent)

  3. Check for spam/abuse
     // Rate limiting with token bucket algorithm [28]
     userBucket = getTokenBucket(userId)
     IF NOT userBucket.tryConsume(1) THEN
        Return error "Rate limit exceeded"
     // Content moderation using AI [29]
     toxicityScore = checkToxicity(sanitizedContent)
     IF toxicityScore > 0.7 THEN
        flagForModeration(userId, sanitizedContent)
        Return error "Message flagged for review"

  4. Create message record
     BEGIN TRANSACTION
     message = {
        id: generateUUID(),
        senderId: userId,
        communityId: communityId,
        content: sanitizedContent,
        createdAt: CURRENT_TIMESTAMP
     }
     INSERT INTO Message VALUES (message)
     COMMIT

  5. Fetch active community members
     // Redis cache for online users [30]
     onlineMembers = getOnlineMembersFromCache(communityId)

     IF onlineMembers IS EMPTY THEN
```

```
    // Fallback to database
    onlineMembers = SELECT userId FROM CommunityMember
                WHERE communityId = communityId
                 AND status = 'Active'

6. Broadcast via WebSocket
  // Publish-Subscribe pattern [31]
  messagePayload = {
    id: message.id,
    sender: {
      id: userId,
      username: getCurrentUsername(userId)
    },
    communityId: communityId,
    content: sanitizedContent,
    createdAt: message.createdAt
  }

  // Redis Pub/Sub for horizontal scaling [32]
  redisPublisher.publish(
    channel: `community:${communityId}:messages`,
    data: messagePayload
  )
  // WebSocket server receives from Redis and broadcasts
  FOR EACH memberId IN onlineMembers DO
     socketConnection = getSocketConnection(memberId)
     IF socketConnection IS NOT NULL THEN
        socketConnection.emit('new_message', messagePayload)

7. Send push notifications to offline users
  // Asynchronous notification queue [33]
  offlineMembers = onlineMembers.filter(m => !isOnline(m))
  FOR EACH memberId IN offlineMembers DO
     queueNotification({
        userId: memberId,
        type: 'new_message',
        title: `New message in ${getCommunityName(communityId)}`,
        body: truncate(sanitizedContent, 100),
        data: { messageId: message.id, communityId }
     })

8. Update community activity metrics
  // Time-series data for analytics [34]
  recordMetric('community.message.sent', {
     communityId: communityId,
     timestamp: CURRENT_TIMESTAMP
  })
```

```
    // Update last activity timestamp
    UPDATE Community
    SET updatedAt = CURRENT_TIMESTAMP
    WHERE id = communityId

  9. RETURN message
END
```

(Sandhu, R. S., Coyne, E. J., Feinstein, H. L., & Youman, C. E., 1996)

6.2.6 Leaderboard Ranking Algorithm

Algorithm: UpdateLeaderboard

Input: scope (global/community), communityId (optional), period (all_time/weekly/monthly)

Output: Updated ranked leaderboard

```
BEGIN
  1. Determine leaderboard scope and fetch data
    IF scope = 'global' THEN
      // Global leaderboard based on total XP [35]
      users = SELECT id, UserName, xp, level
              FROM Users
              WHERE isBanned = false
              ORDER BY xp DESC, level DESC, createdAt ASC
              LIMIT 1000  // Top 1000 users
  ELSE IF scope = 'community' THEN
    // Community-specific leaderboard
    users = SELECT
            cm.userId as id,
            u.UserName,
            cm.totalXP as xp,
            cm.level
          FROM CommunityMember cm
          JOIN Users u ON cm.userId = u.id
          WHERE cm.communityId = communityId
            AND cm.status = 'Active'
            AND u.isBanned = false
          ORDER BY cm.totalXP DESC, cm.level DESC, cm.joinedAt ASC
  END IF

2. Apply time period filter if needed
  IF period = 'weekly' THEN
    // Calculate XP gained this week [36]
    weekStart = getStartOfWeek(CURRENT_DATE)
    users = SELECT
            u.id,
            u.UserName,
            SUM(q.xpValue) as weeklyXP
          FROM Users u
```

```
            JOIN Quest q ON u.id = q.userId
            WHERE q.completedAt >= weekStart
              AND q.isCompleted = true
            GROUP BY u.id, u.UserName
            ORDER BY weeklyXP DESC

    ELSE IF period = 'monthly' THEN
        monthStart = getStartOfMonth(CURRENT_DATE)
        // Similar query with monthStart filter
    END IF

3. Calculate ranks with tie-breaking [37]
    // Dense ranking: users with same score get same rank
    currentRank = 1
    previousScore = NULL
    sameRankCount = 0

    FOR EACH user IN users DO
        IF user.xp = previousScore THEN
            // Tie: assign same rank
            user.rank = currentRank
            sameRankCount++
        ELSE
            // New score: increment rank
            currentRank = currentRank + sameRankCount
            user.rank = currentRank
            sameRankCount = 1
            previousScore = user.xp
        END IF
    END FOR

4. Store leaderboard in cache
    // Redis sorted set for O(log N) operations [38]
    cacheKey = `leaderboard:${scope}:${period}`
    IF scope = 'community' THEN
        cacheKey = `leaderboard:community:${communityId}:${period}`

    FOR EACH user IN users DO
        // ZADD command: score = negative rank for ascending order
        redis.ZADD(cacheKey, user.rank, user.id)

        // Store user details in hash
        redis.HSET(`user:${user.id}:leaderboard`, {
            rank: user.rank,
            score: user.xp,
            username: user.UserName
        })
    END FOR
```

```
  // Set expiration based on period
  IF period = 'weekly' THEN
     redis.EXPIRE(cacheKey, 7 * 24 * 3600)  // 7 days
  ELSE IF period = 'monthly' THEN
     redis.EXPIRE(cacheKey, 30 * 24 * 3600)  // 30 days
  ELSE
     redis.EXPIRE(cacheKey, 24 * 3600)  // 1 day for all_time

5. Update database leaderboard table
  // Batch upsert for efficiency [39]
  BEGIN TRANSACTION

  DELETE FROM Leaderboard
  WHERE leaderboardType = scope
    AND period = period
    AND (communityId = communityId OR communityId IS NULL)

  FOR EACH user IN users DO
     INSERT INTO Leaderboard (
        id,
        userId,
        communityId,
        rank,
            score,
            leaderboardType,
            period,
            updatedAt
        ) VALUES (
            generateUUID(),
            user.id,
            communityId,
            user.rank,
            user.xp,
            scope,
            period,
            CURRENT_TIMESTAMP
        )
    END FOR

    COMMIT

6. Broadcast rank changes via WebSocket
    // Real-time leaderboard updates [40]
    FOR EACH user IN users DO
        IF hasRankChanged(user.id, user.rank) THEN
            notifyUser(user.id, {
                type: 'rank_change',
                newRank: user.rank,
                leaderboard: scope,
                period: period
            })

    7. RETURN leaderboard data
      RETURN {
          leaderboard: users.map(u => ({
              rank: u.rank,
              userId: u.id,
              username: u.UserName,
              score: u.xp,
              level: u.level
          })),
          total: users.length,
          updatedAt: CURRENT_TIMESTAMP
      }
END

// Helper: Efficient rank retrieval for single user
Function getUserRank(userId, scope, period):
    // O(log N) lookup using Redis sorted set [41]
    cacheKey = `leaderboard:${scope}:${period}`
    rank = redis.ZRANK(cacheKey, userId)
    score = redis.ZSCORE(cacheKey, userId)

    RETURN { rank: rank + 1, score }  // +1 because ZRANK is 0-indexed
```

(Date, 2003)

6.3 Flow Chart

Flowcharts are visual diagrams that represent the flow of processes, decisions, and user interactions within the LevelUp platform. They use standardized symbols to map out system logic and user journeys, making complex processes easier to understand and implement.

Purpose in LevelUp

Flowcharts serve multiple critical functions in the LevelUp system:

1. **Process Visualization** - Illustrate how users move through authentication, quest completion, community interactions, and other core features
2. **Decision Logic** - Show conditional branches (e.g., "Is user verified?", "Quest completed?")
3. **Development Guide** - Provide developers with clear implementation roadmaps
4. **Documentation** - Create maintainable visual documentation for system workflows
5. **Testing Reference** - Help QA teams identify test scenarios and edge cases

6.3.1 User Dashboard Flowchart

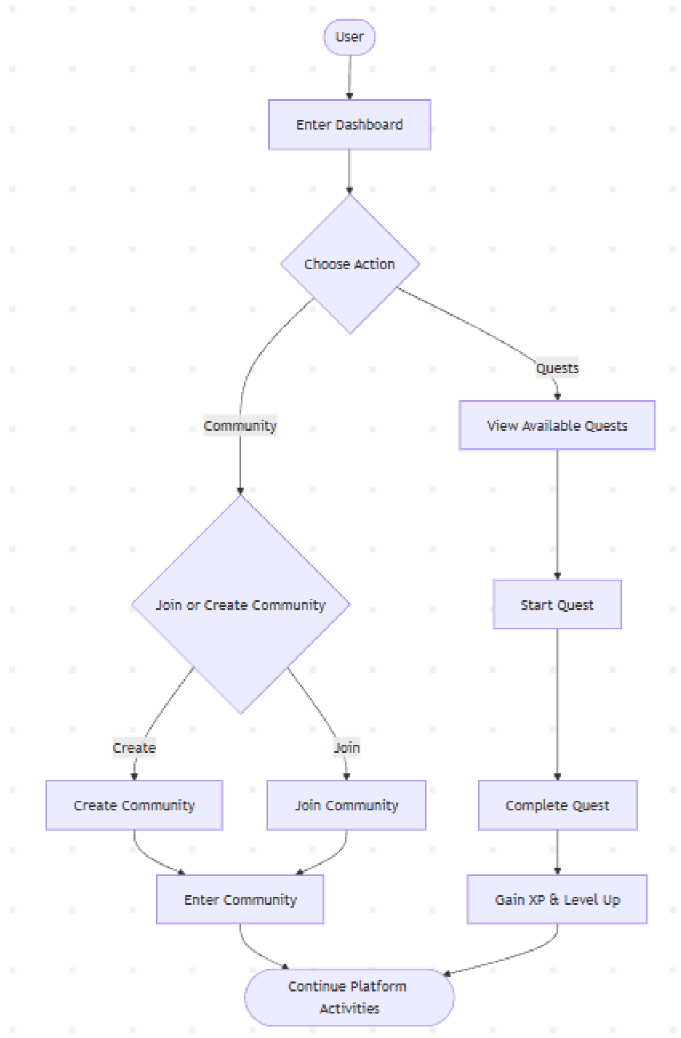

Figure 6.3.1: Flowchart (User Dashboard)

6.3.2 Community Flowchart

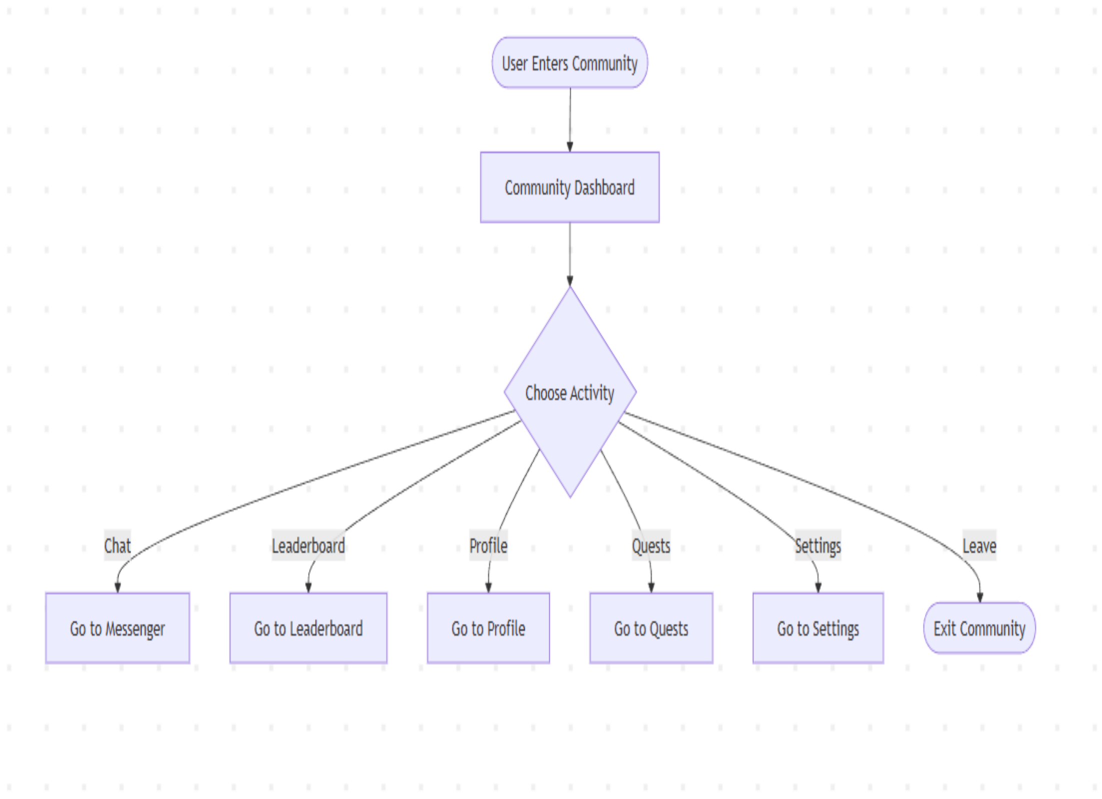

Figure 6.3.2: Flowchart (Community)

6.3.3 Community Leaderboard Flowchart

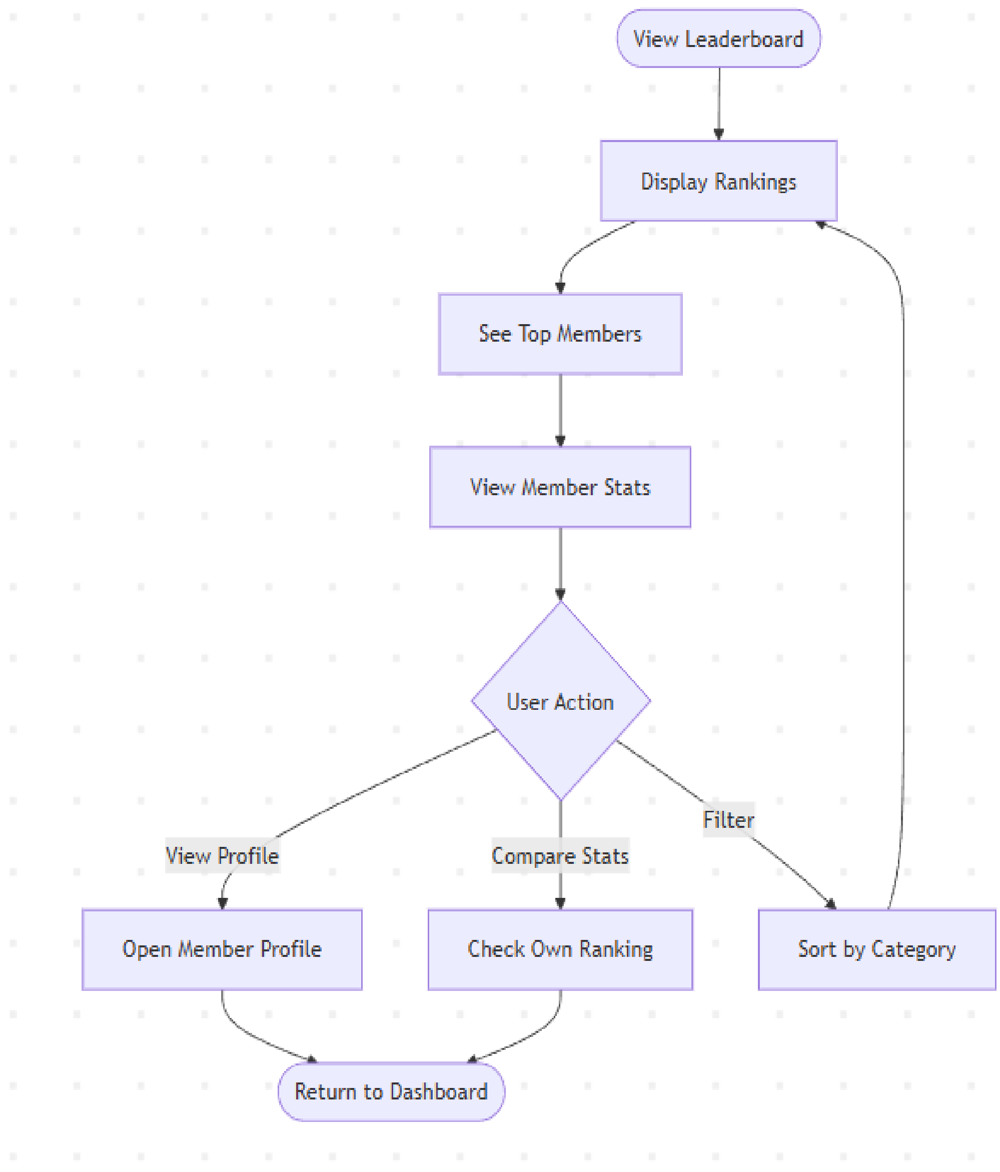

Figure 6.3.3: Flowchart (Community Leaderboard)

6.3.4 Community Messenger Flowchart

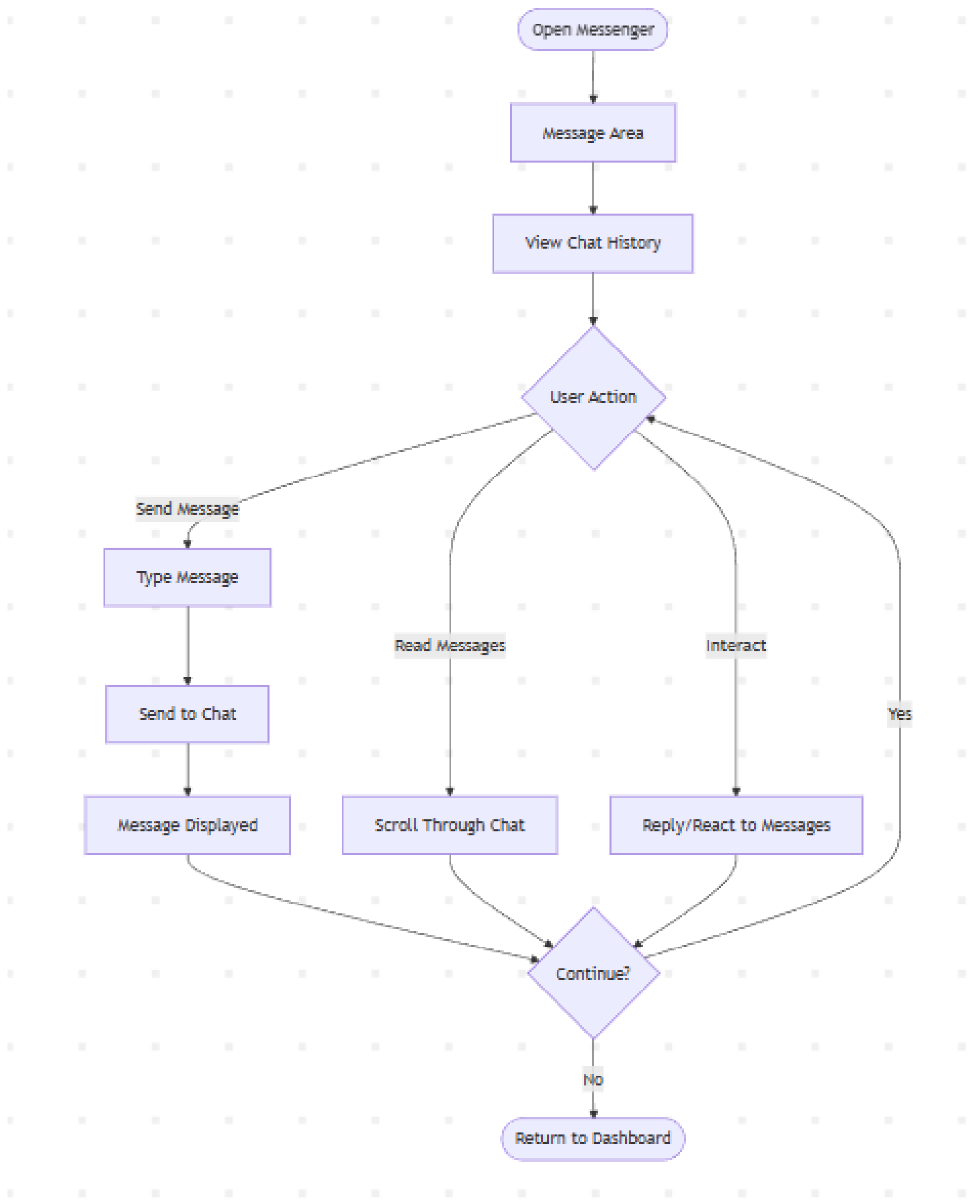

Figure 6.3.4: Flowchart (Community Messenger)

6.3.5 Community Profile Flowchart

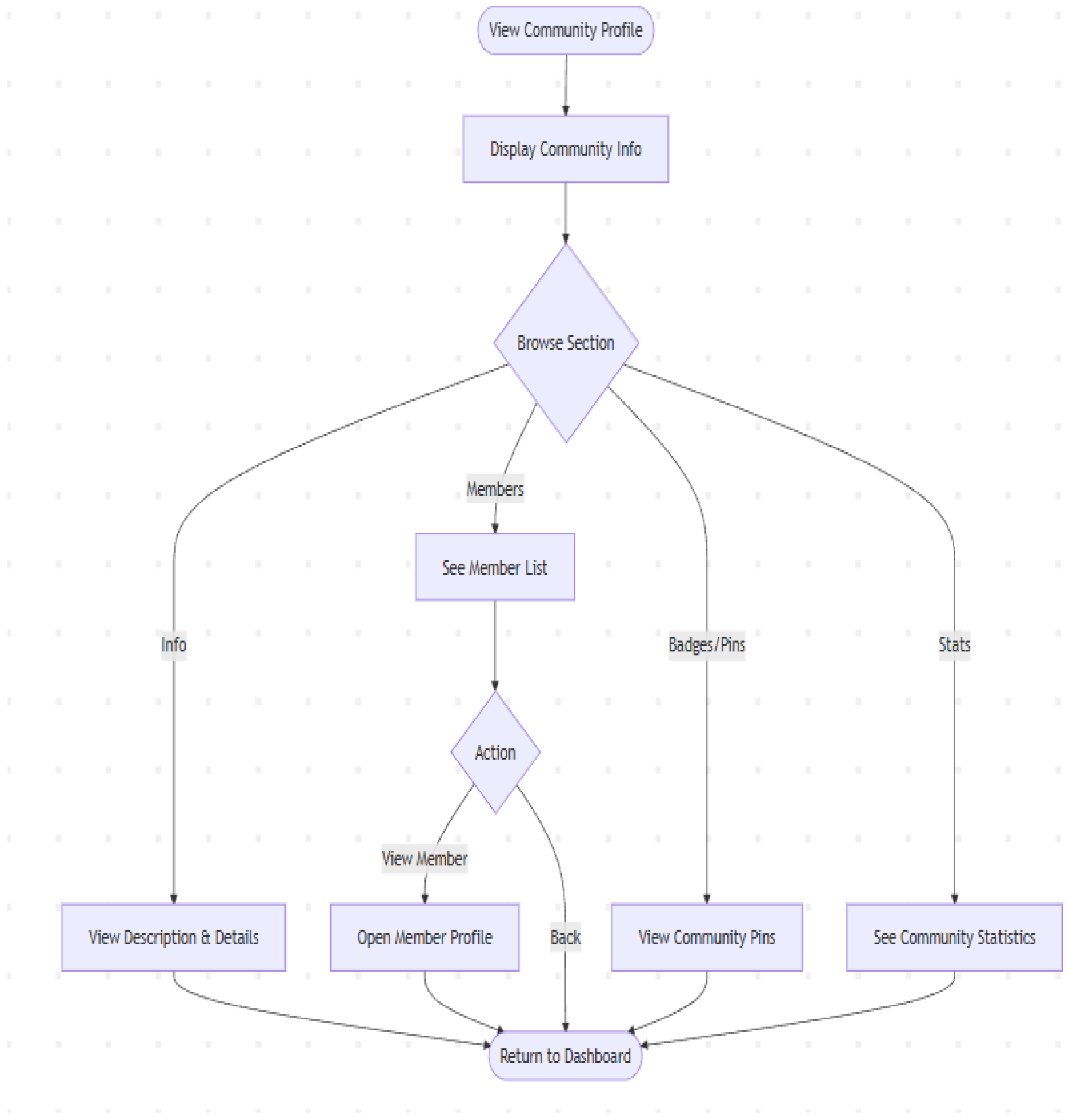

Figure 6.3.2: Flowchart (Community Profile)

6.3.6 Community Quests Flowchart

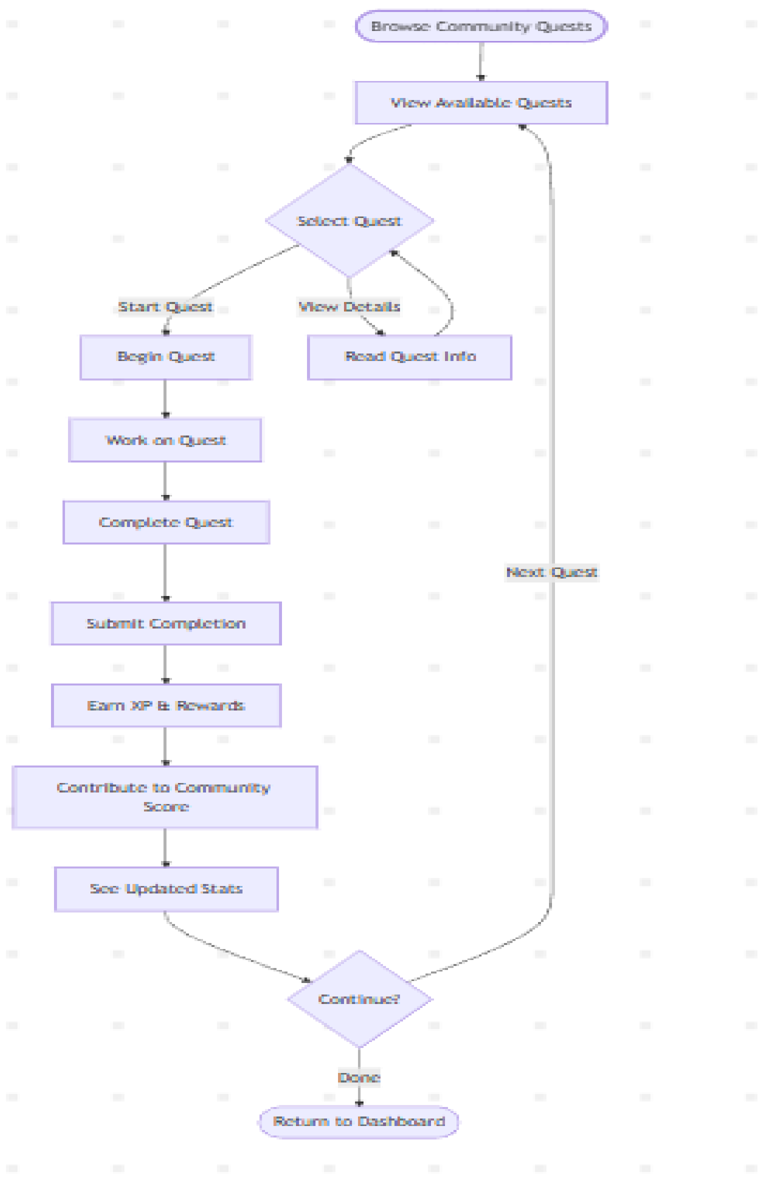

Figure 6.3.2: Flowchart (Community Quests)

6.3.7 Community Settings Flowchart

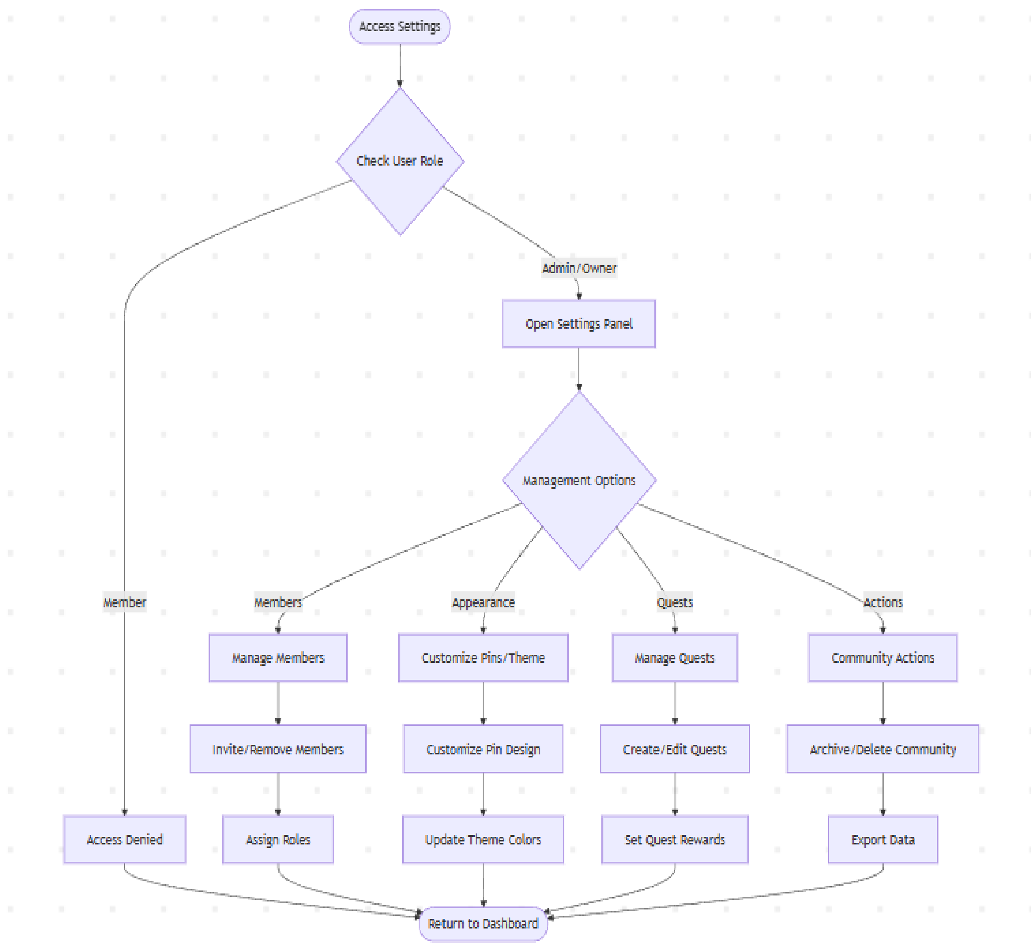

Figure 6.3.7: Flowchart (Community Settings)

6.3.8 Admin Dashboard Flowchart

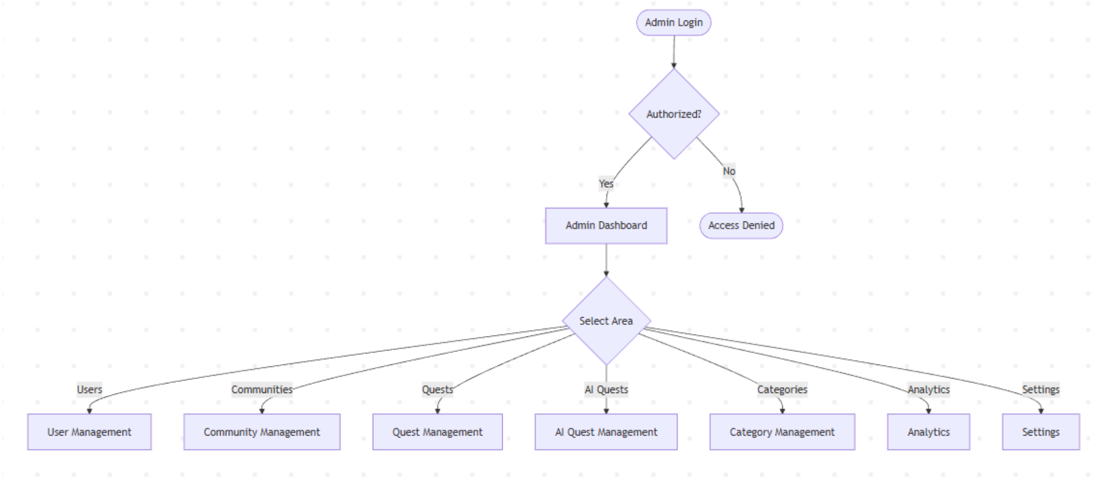

Figure 6.3.8: Flowchart (Admin Dashboard)

6.3.9 Admin User Management Flowchart

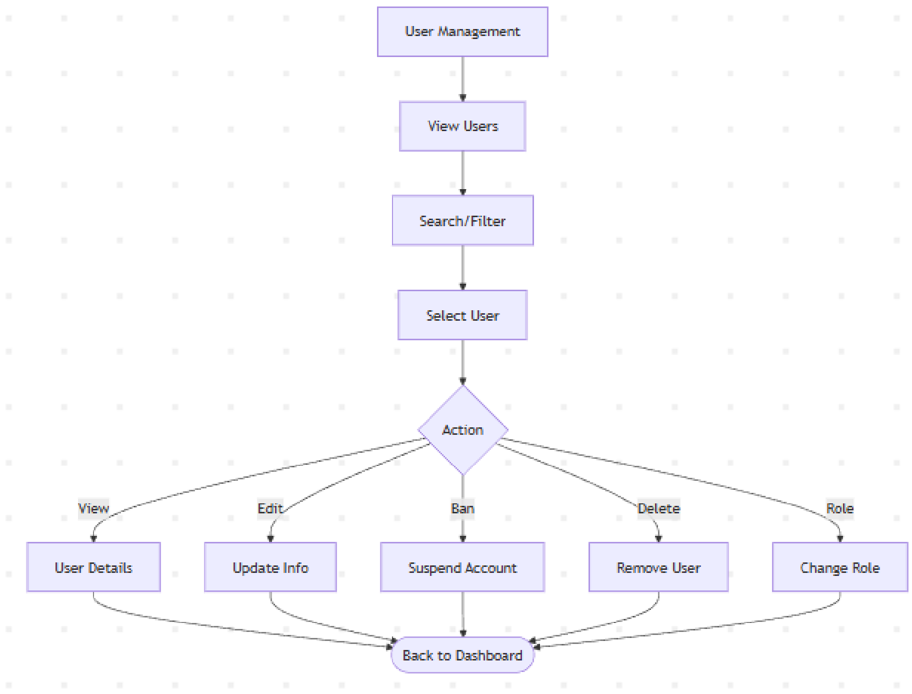

Figure 6.3.9: Flowchart (Admin User Management)

6.3.10 Admin Community Management Flowchart

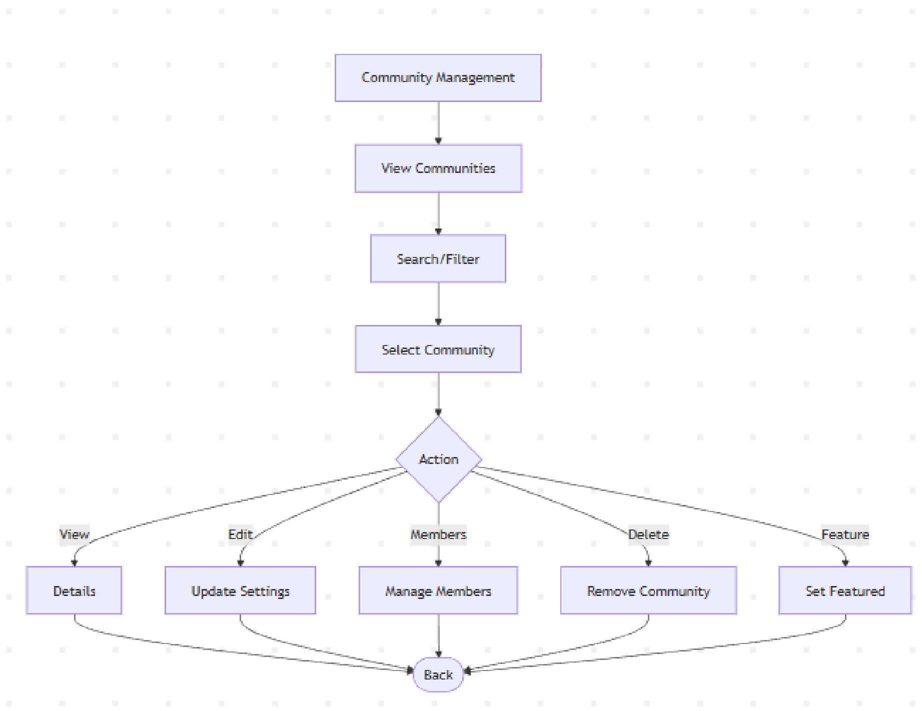

Figure 6.3.8: Flowchart (Admin Community Management)

6.3.11 Admin Category Management Flowchart

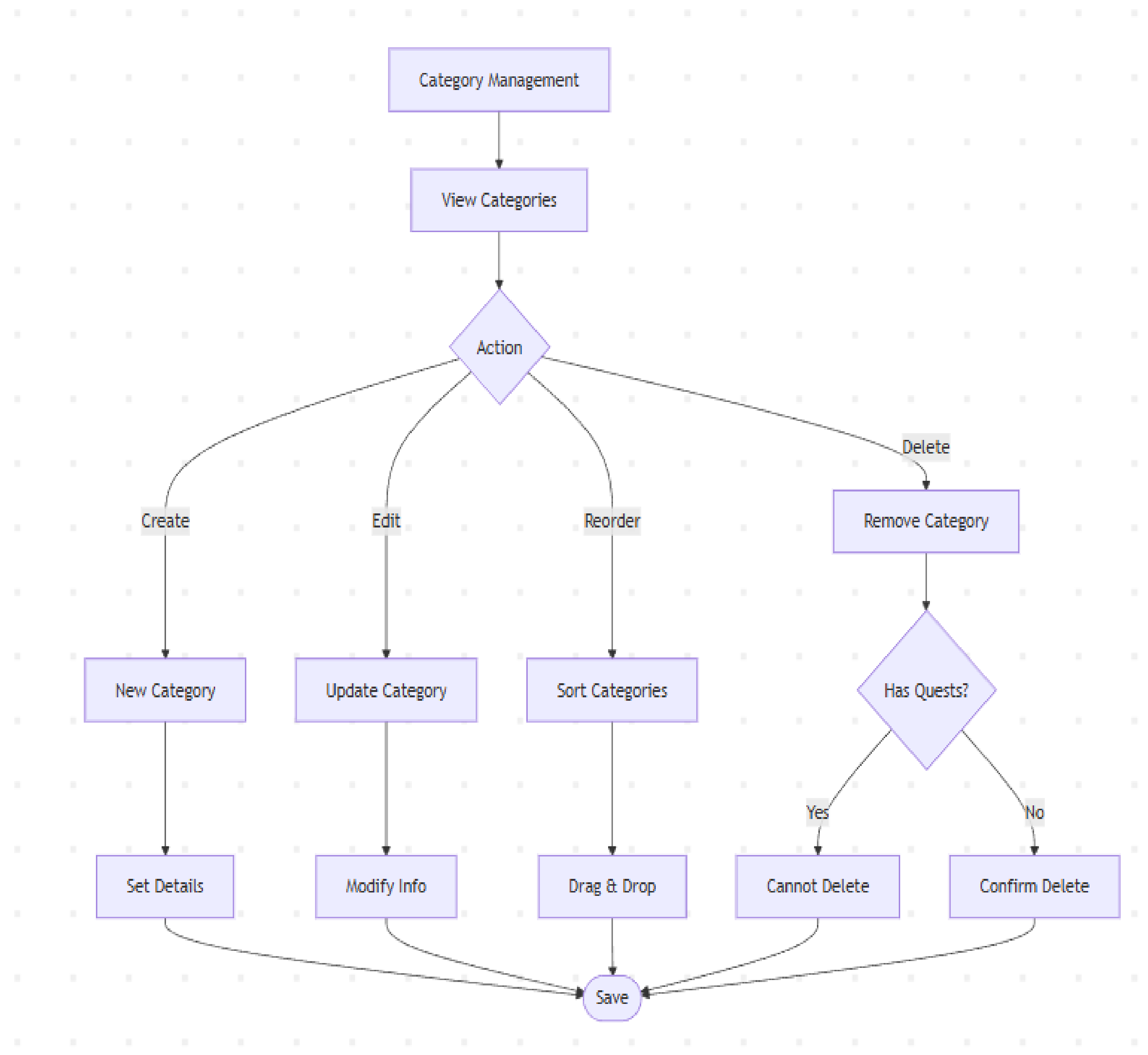

Figure 6.3.11: Flowchart (Admin Category Management)

6.3.12 Admin System Analysis Flowchart

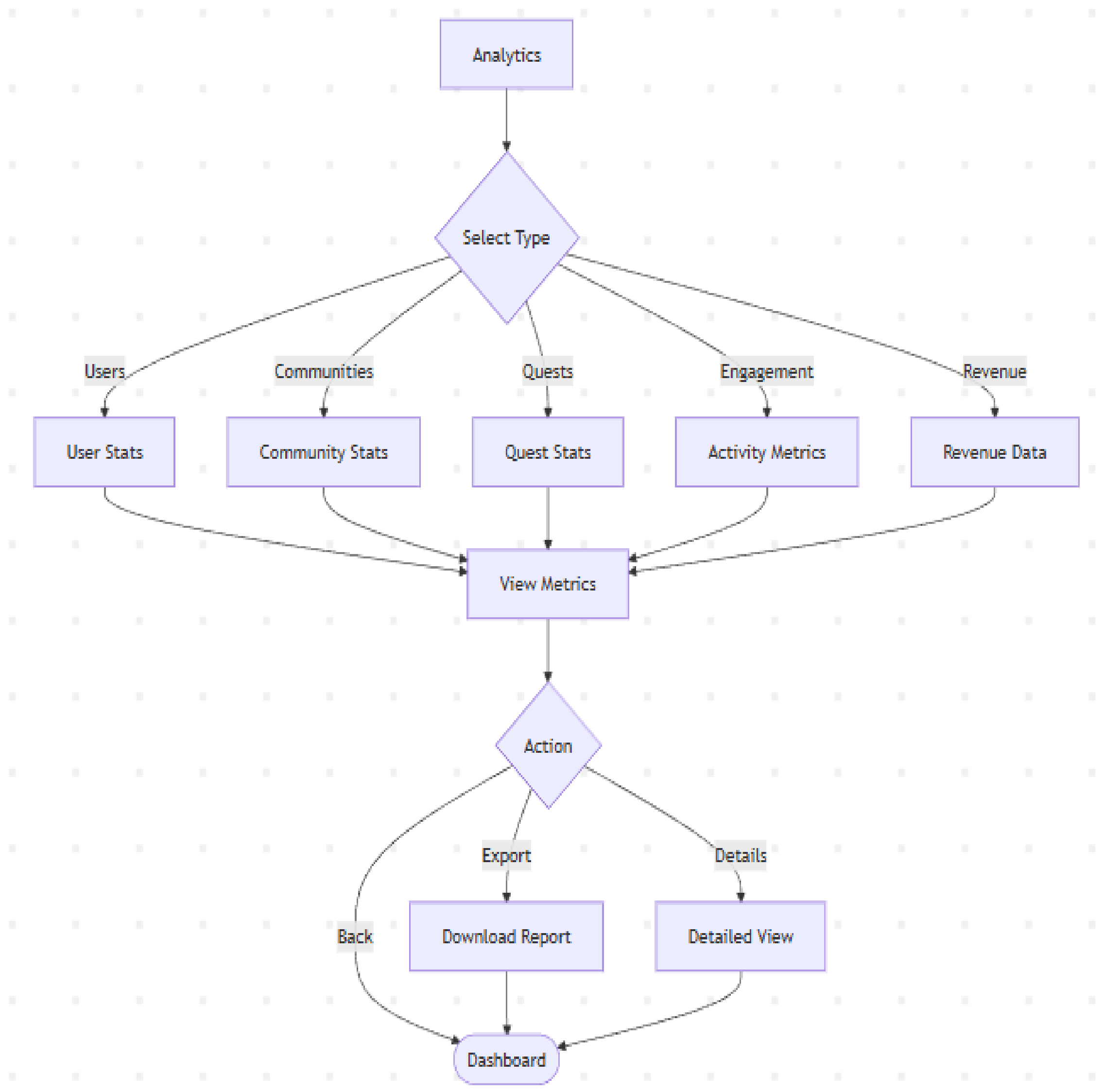

Figure 6.3.12: Flowchart (Admin System Analysis)

6.4 ER Diagram

Entity-Relationship (ER) diagram for LevelUp involves identifying the main entities, their attributes, and the relationships between them. Here's a simplified ER diagram for LevelUp (gamified learning platform):

Entities:

- User - Learners who participate in quests and join communities
- Community - Groups organized around specific topics or interests
- Quest - Daily and weekly challenges that users can complete
- Clan - Teams formed by users for collaborative competition
- Admin - System administrators with elevated privileges
- CommunityMembership - Links users to communities they've joined
- ClanMembership - Links users to clans they're part of
- QuestCompletion - Records of completed quests by users
- Message - Communication within communities
- Leaderboard - Rankings for users, communities, and clans

6.4.1 User Side ER Diagram

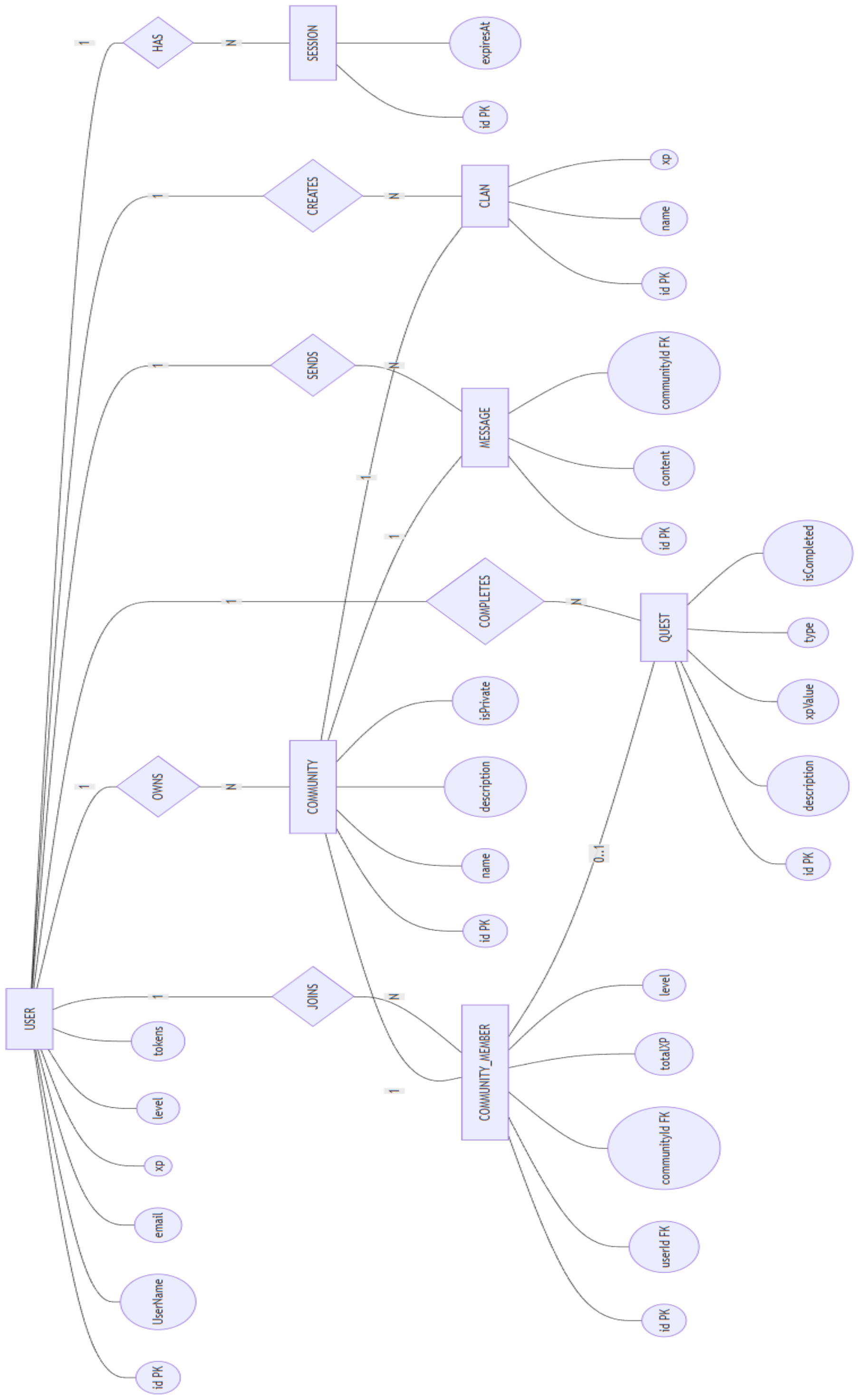

Figure 6.4.1: ER Diagram (User Side)

6.4.2 Admin Side ER Diagram

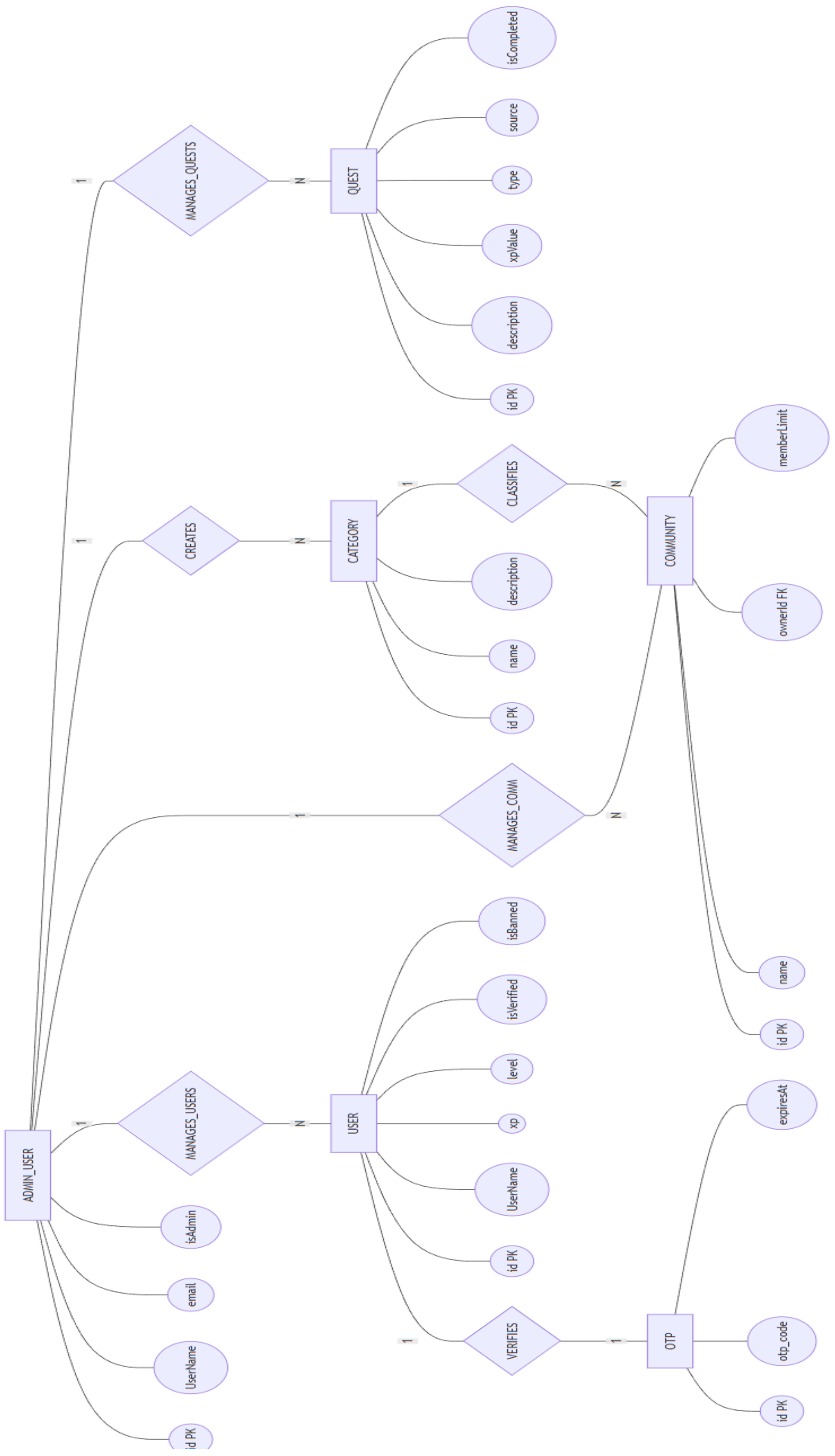

Figure 6.4.2: ER Diagram (Admin Side)

6.5 Use Case Diagram

6.5.1 System Use Case

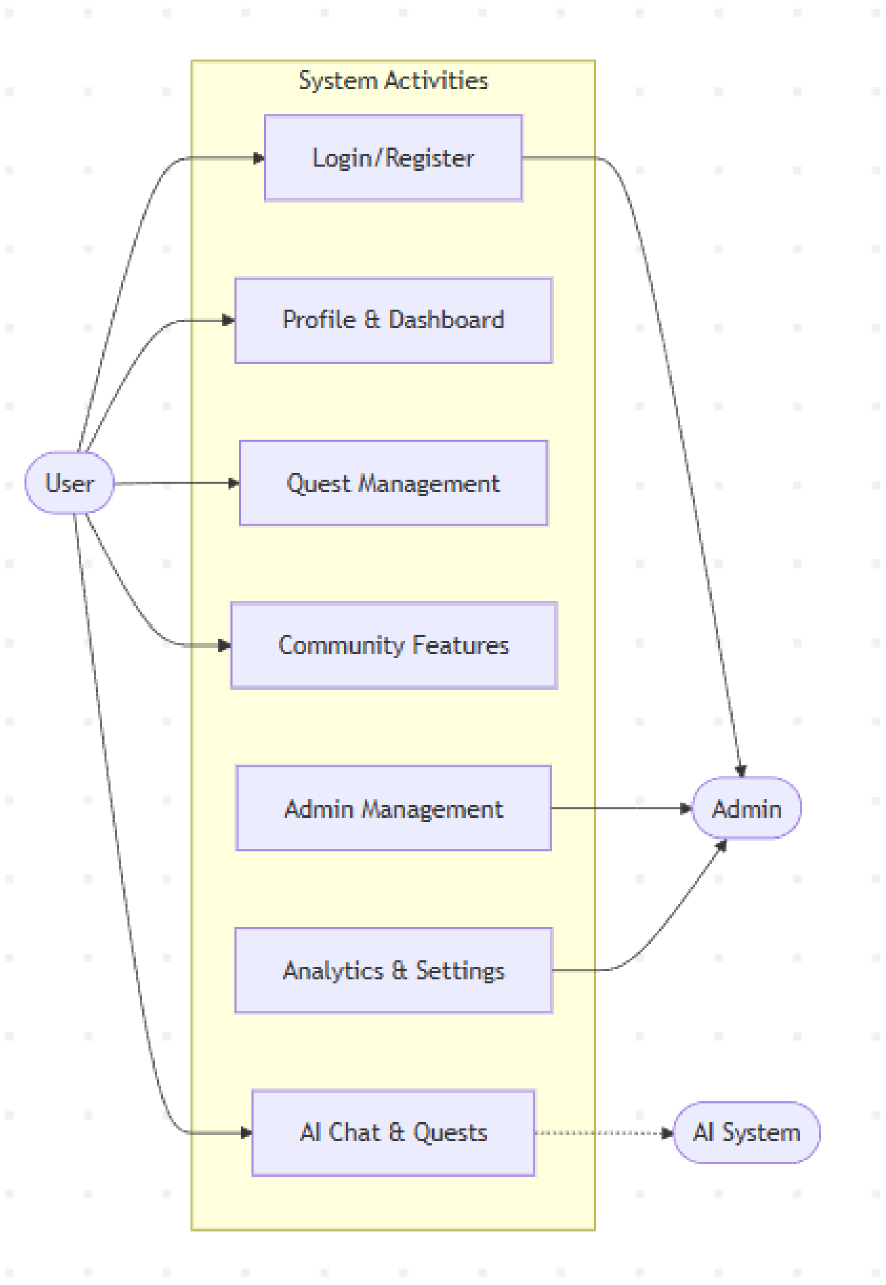

Figure 6.5.1: Use Case Diagram (System)

6.5.2 Authentication Use Case

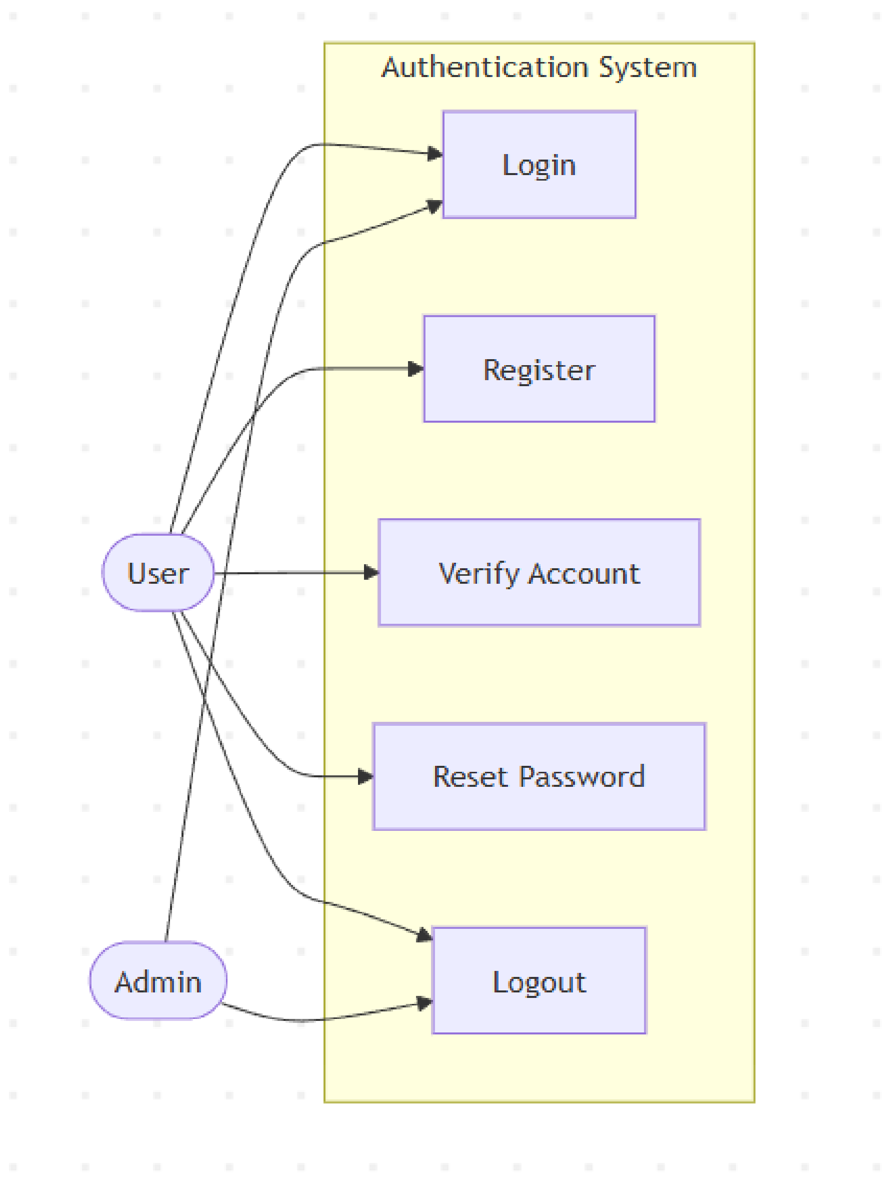

Figure 6.5.2: Use Case Diagram (Authentication)

6.5.3 User Dashboard Use Case

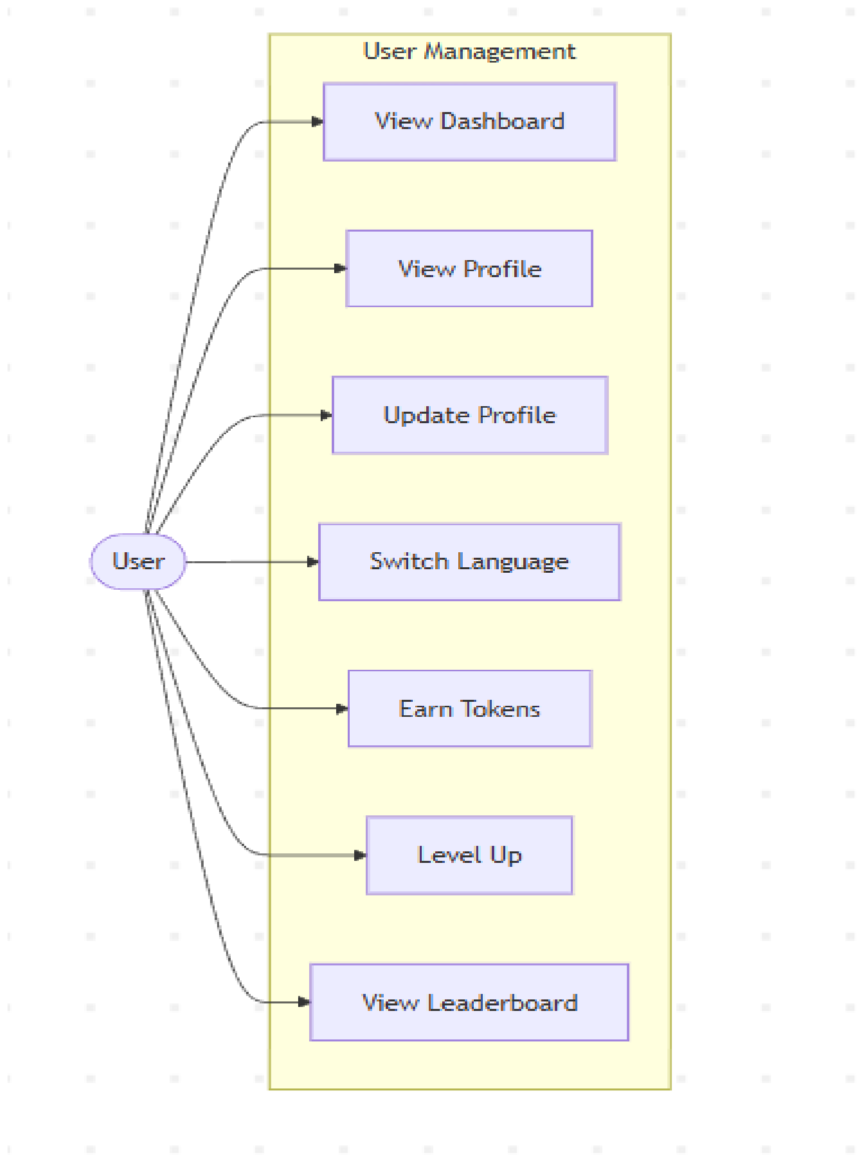

Figure 6.5.3: Use Case Diagram (User Dashboard)

6.5.4 Admin Use Case

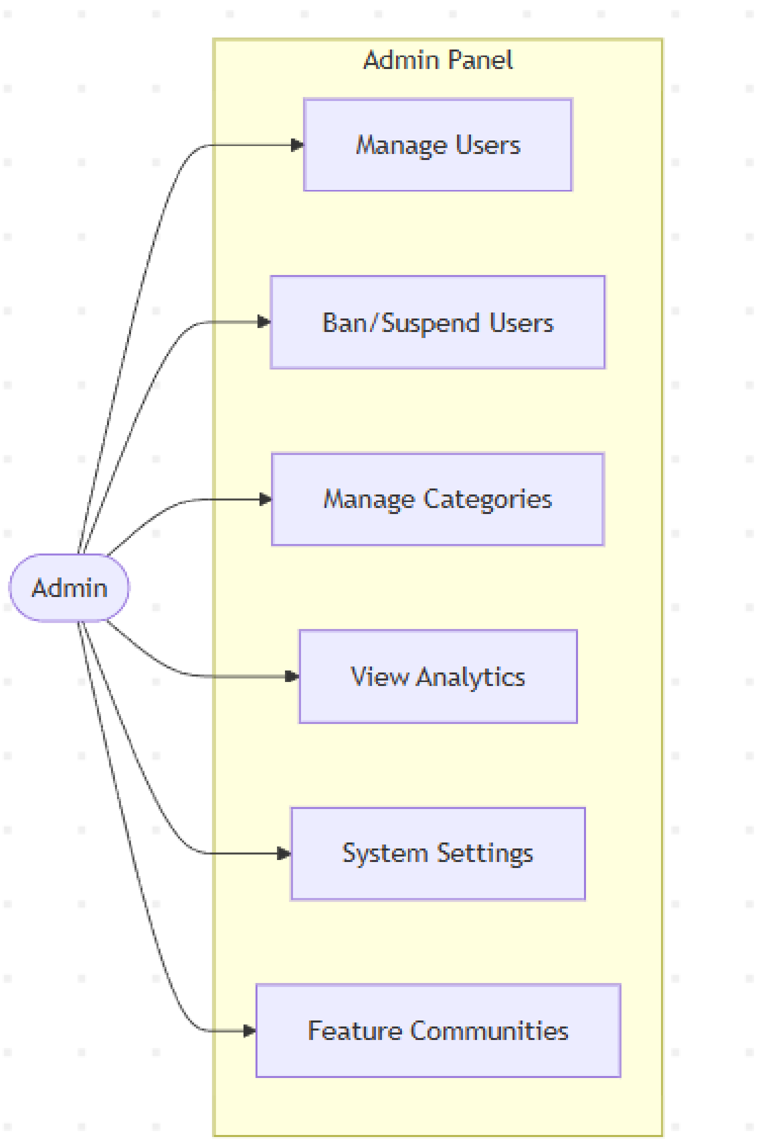

Figure 6.5.1: Use Case Diagram (Admin)

6.5.5 Community Use Case

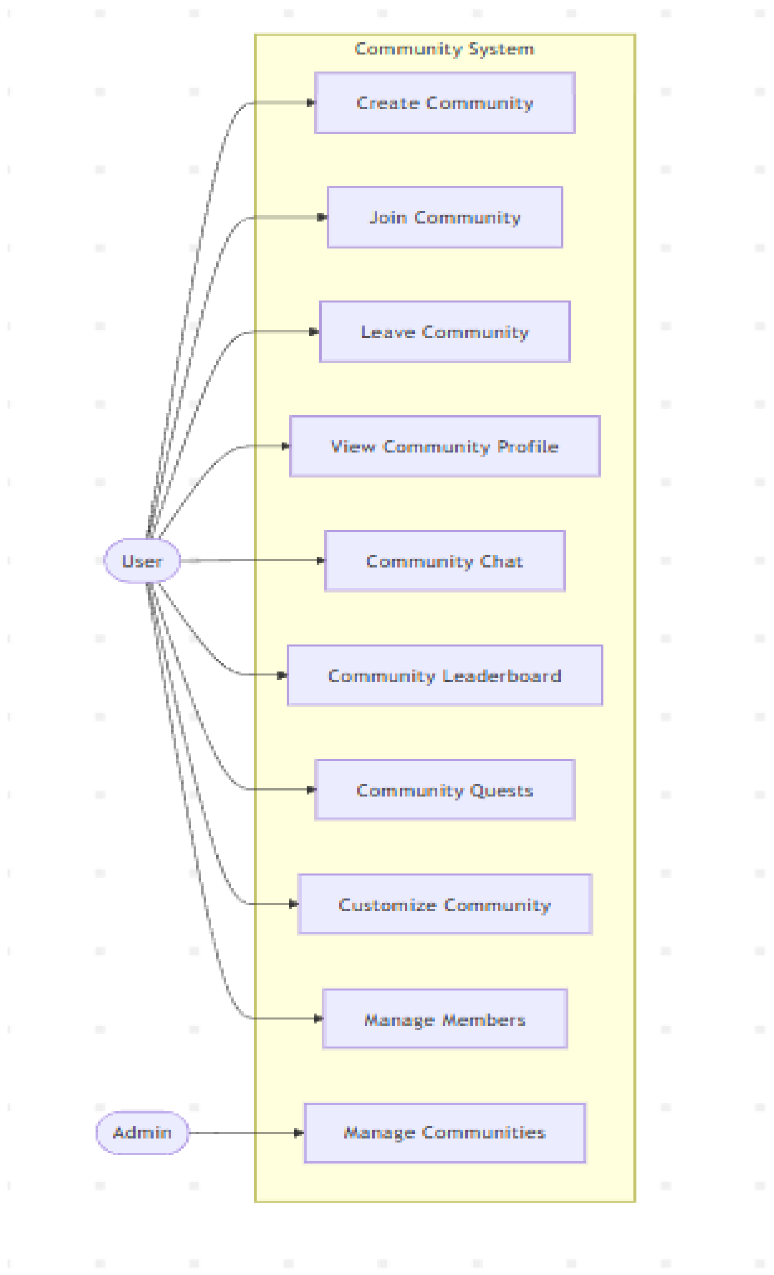

Figure 6.5.5: Use Case Diagram (Community)

6.5.6 Quest Management Use Case

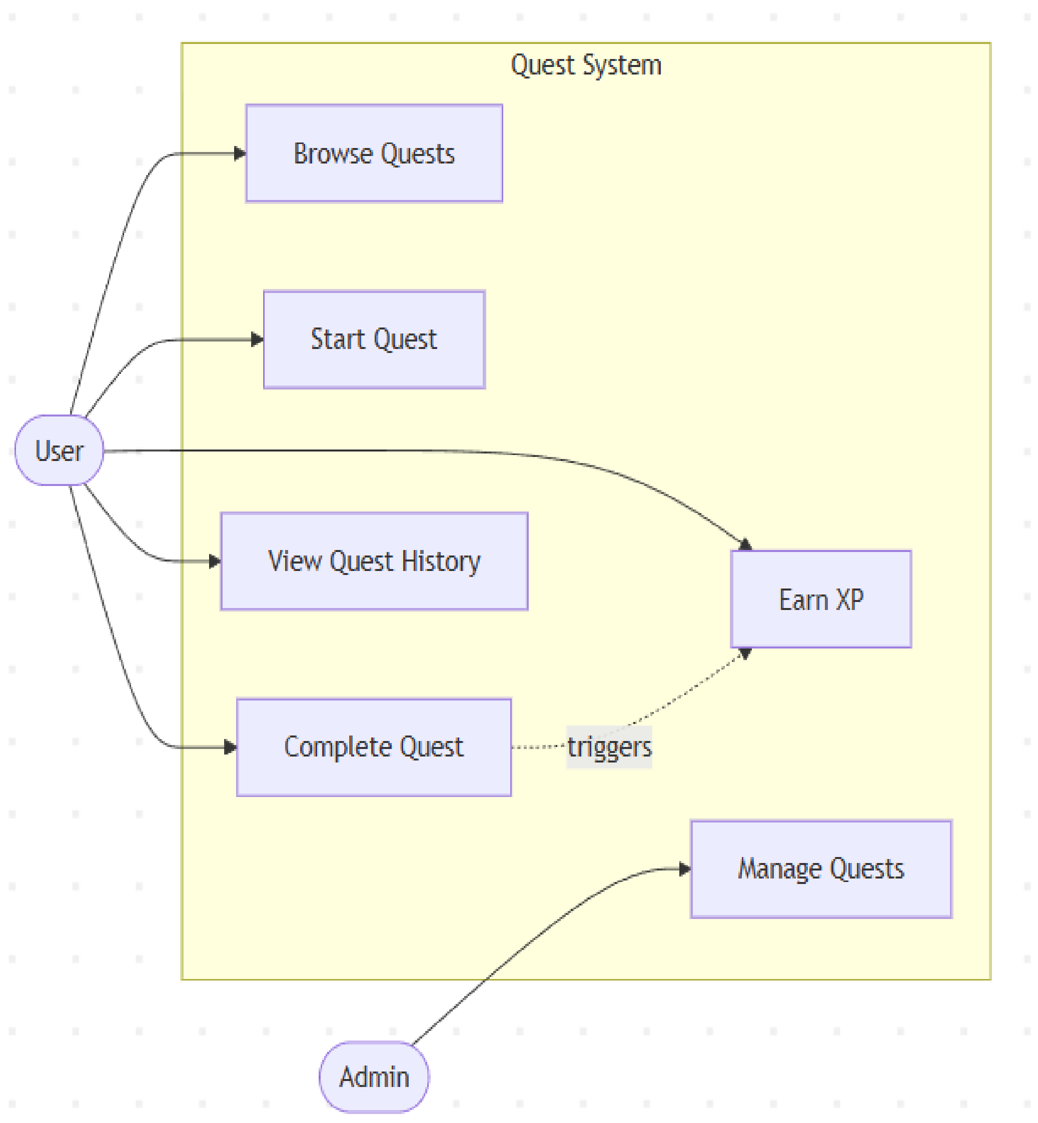

Figure 6.5.6: Use Case Diagram (Quest Management)

7. Development

7.1 Development Methodology

For To ensure LevelUp evolves with user needs and stays on schedule, the project followed an **Agile development framework**, specifically the **Scrum** style of Agile. This approach emphasizes flexibility, rapid iteration, and close collaboration between all team members.

1. Project Planning & Backlog Creation

- **Define Vision & Scope:** Clearly outline LevelUp's core goals, community-driven learning, AI-generated quests, and gamified progression.
- **Product Backlog:** Break these goals into user stories and features, prioritized by importance and dependencies.
- **Estimation:** Use story points to estimate effort for each backlog item.

2. Sprint Planning

- **Sprint Length:** Adopt two-week sprints to balance steady progress with frequent feedback.
- **Team Roles:**

o **Development Team:** Designers, front-end, and back-end developers share responsibility for delivering sprint goals.

3. Iterative Development

- **Design → Build → Test Loop:** Each sprint covers requirement refinement, coding, UI/UX design, and automated/manual testing.
- **Incremental Delivery:** Every sprint produces a working build of the app—such as an early prototype of AI quests or clan features.

4. Daily Stand-ups

- 15-minute meetings where the team shares what was done yesterday, plans for today, and any blockers.
- Promotes transparency and quick problem-solving.

5. Sprint Review & Demo

- At the end of each sprint, the team demonstrates the new functionality (e.g., a working chat feature or quest generator) to stakeholders.
- Feedback is recorded and turned into new backlog items.

6. Sprint Retrospective

- The team reflects on what went well, what didn't, and how to improve processes for the next sprint.
- Encourages continuous improvement.

7. Continuous Integration & Deployment

- Code is merged frequently into a shared repository with automated testing to catch issues early.
- Small, frequent releases allow early users to experience new features and provide real-world feedback.

8. Ongoing User Feedback

- Early beta testers and selected community members will provide input after each release.

Feedback loops ensure features like AI-generated quests and gamification evolve according to actual user need.

(rosemet, 2025)

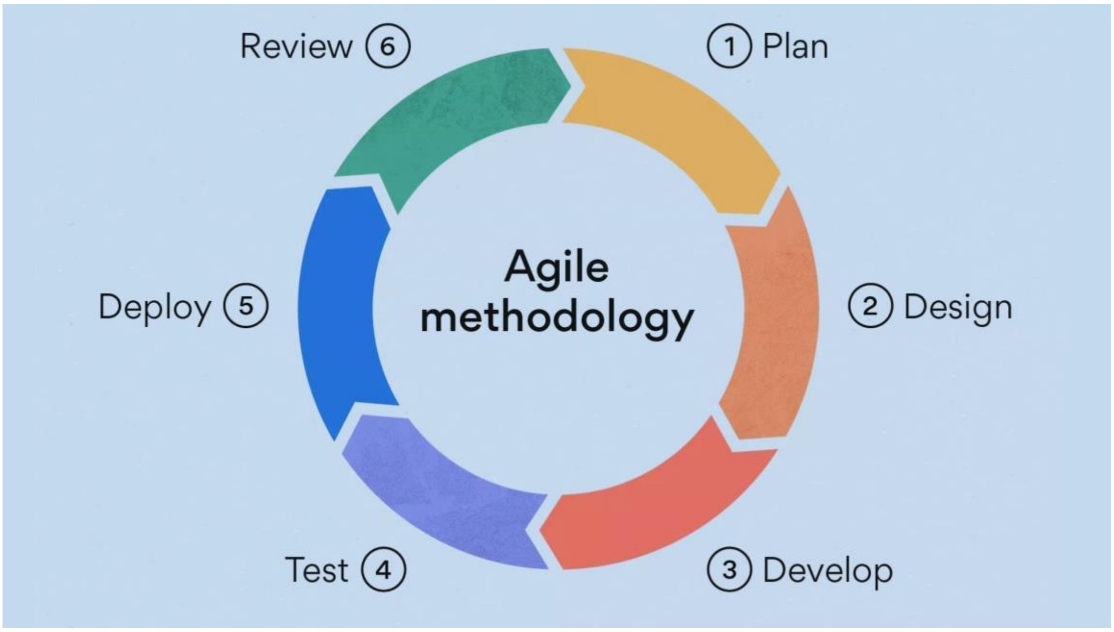

Figure 7.1: Agile Methodology

7.2 Work Assign

The following table shows the activities done by the team members:

S.N.	Name of the member	Work assigned	Remarks
1.	Bishal Adhikari	• Document • Problem Identification • System Design • System coding • Testing	
2.	Krishna Bahadur Gurung	• Documentation • Planning • System Coding • System Design • Testing	

3.	Suyan Thapa	• Testing • Coding • Requirement Document • Documentation	

Figure 7.2: Work Assign

7.3 Project Gantt chart

In the context of developing a Bookly, a Gantt chart for the project includes various tasks and milestones related to the system's development.

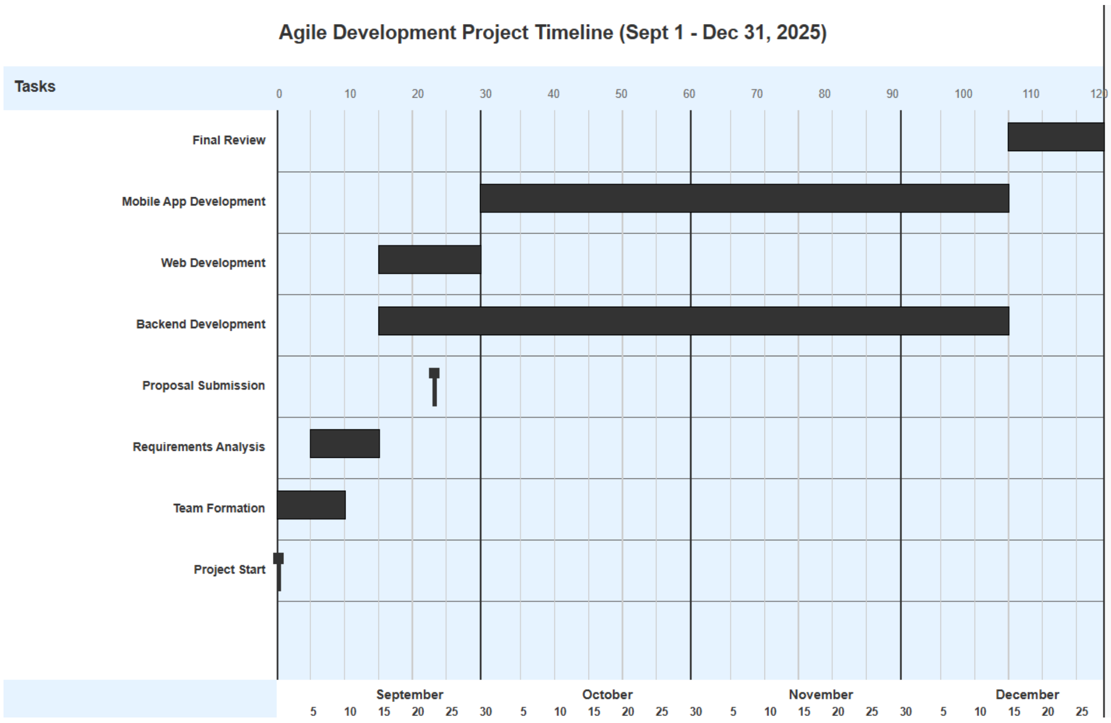

Figure 7.3: Gantt Chart

8. Testing

Test Objectives

Testing is the process of validating the correctness of a program. This document outlines comprehensive test cases for the LevelUp gamification platform, covering authentication, user features, admin functions, and community management.

1. Authentication Module Testing

Title: Module testing of Authentication System

Description: A user should be able to register, log in, verify email, and reset password using proper credentials.

Test Case ID	**Test Case**	**Input**	**Expected Result**
1.1	Verify User Registration	Fill username, email, and password fields and submit	User account created successfully, verification email sent
1.2	Verify Login with Valid Credentials	Enter valid email and password	User logged in and redirected to dashboard
1.3	Verify Login with Invalid Credentials	Enter incorrect email or password	Error message **"Invalid credentials"** displayed
1.4	Verify Email Verification	Click verification link from email	Account verified, user redirected to login page
1.5	Verify Password Reset Request	Enter registered email in forget password form	Password reset link sent to email
1.6	Verify Password Reset Functionality	Enter new password via reset link	Password updated successfully, user can login with new password

1.7	Verify OAuth Login (Google)	Click **"Continue with Google"** button	User authenticated via Google and redirected to dashboard
1.8	Verify OAuth Login (GitHub)	Click **"Continue with GitHub"** button	User authenticated via GitHub and redirected to dashboard
1.9	Verify Registration with Existing Email	Try to register with already registered email	Error message **"Email already exists"** displayed
1.10	Verify Logout Functionality	Click logout button	User logged out and redirected to login page

Figure 8.1: Authentication Testing

2. User Dashboard & Features Testing

Title: Testing User Dashboard and Core Features

Description: User can access dashboard, manage quests, join communities, and interact with features after login.

Test Case ID	**Test Case**	**Input**	**Expected Result**
2.1	Verify Dashboard Access	Navigate to dashboard after login	Dashboard displays with user stats, quests, and communities
2.2	Verify Profile View	Click on profile link	User profile displayed with avatar, username, email, and stats
2.3	Verify Profile Editing	Update profile picture and details	Profile updated successfully with new information
2.4	Verify Language Switcher	Select different language from dropdown	Interface language changes accordingly

2.5	Verify Token Display	View user token balance	Current token balance displayed correctly
2.6	Verify Navigation Menu	Click on different menu items	Correct pages loaded without errors
2.7	Test Search Functionality	Enter search query in search bar	Relevant results displayed (communities, quests, users)
2.8	Verify Responsive Design	Access dashboard on mobile device	Dashboard displays correctly on mobile screen
2.9	Verify Dark Mode Toggle	Toggle dark/light mode	Theme switches correctly across all pages
2.10	Verify Notifications	Trigger notification event	Toast notification displayed with correct message

Figure 8.2: User homepage Test

3. Quest Management Testing

Title: Testing Quest System

Description: Users can view, start, complete, and track daily and weekly quests.

Test Case ID	**Test Case**	**Input**	**Expected Result**
3.1	Verify Daily Quests Display	Navigate to quests section	Daily quests displayed with details and status
3.2	Verify Weekly Quests Display	Navigate to weekly quests tab	Weekly quests displayed with details and status
3.3	Verify Starting a Quest	Click **"Start Quest"** button on available quest	Quest status changes to **"In Progress"**, timer starts
3.4	Verify Quest Timer	View quest in progress	Countdown timer displays remaining time accurately

3.5	Verify Completing a Quest	Click **"Complete Quest"** button	Quest marked as completed, rewards credited
3.6	Verify Quest Rewards	Complete a quest	Tokens/points added to user account
3.7	Verify Quest History	Navigate to quest history	Completed quests displayed with timestamps
3.8	Verify Quest Filtering by Community	Select community filter	Only quests for selected community displayed
3.9	Verify Quest Search	Search for specific quest	Matching quests displayed in results
3.10	Verify Quest Expiration	Wait for quest time to expire	Expired quest marked as failed or reset
3.11	Verify AI Quest Generation	Request AI-generated quest	New custom quest created based on user preferences

Figure 8.3: User homepage Test

4. Community Features Testing

Title: Testing Community and Clan Management

Description: Users can create, join, search communities, and participate in clan activities.

Test Case ID	**Test Case**	**Input**	**Expected Result**
4.1	Verify Community Listing	Navigate to communities page	All public communities displayed with details
4.2	Verify Community Search	Enter community name in search	Matching communities displayed
4.3	Verify Creating a Community	Fill community creation form and submit	New community created successfully

4.4	Verify Joining a Public Community	Click **"Join"** on public community	User added to community members
4.5	Verify Joining a Private Community	Request to join private community	Join request sent to community admin
4.6	Verify Community Details View	Click on a community	Community profile, members, and quests displayed
4.7	Verify Community Leaderboard	Navigate to community leaderboard	Top members displayed with scores
4.8	Verify Community Messages	Post message in community chat	Message displayed in chat area
4.9	Verify Community Settings (Owner)	Modify community settings as owner	Settings updated successfully
4.10	Verify Leaving a Community	Click **"Leave Community"** button	User removed from community members
4.11	Verify Clan Creation	Create new clan within community	Clan created and visible to community members
4.12	Verify Joining a Clan	Click **"Join Clan"** button	User added to clan members
4.13	Verify Clan Leaderboard	View clan leaderboard	Clans ranked by total points
4.14	Verify Clan Details	Click on specific clan	Clan members and stats displayed
4.15	Verify Category Filtering	Select category filter	Communities filtered by selected category

Figure 8.4: Community Feature Test

5. AI Chat & Features Testing

Title: Testing AI-Powered Features

Description: Users can interact with AI assistant for quest generation and assistance.

Test Case ID	Test Case	Input	Expected result
5.1	Verify adding a book	Fill the book details in admin panel.	Book added to database and visible to us
5.2	Verify editing book details	Modify details and price or stock of book	Change reflect in the catalog.
5.3	Test deleting a book	Remove a book via admin panel	Book delete from the catalog
5.4	Verify sales and inventory report	Navigate to report section	Book, order and sales report.
5.5	Test editing admin profile details	Modify a admin picture, details and change password	Admin account details changed

Figure 8.5: AI Chat & Features Test

6. Admin Dashboard Testing

Title: Testing Admin Dashboard and Management Features

Description: Admin can manage communities, quests, users, and system settings

Test Case ID	**Test Case**	**Input**	**Expected Result**
6.1	Verify Admin Login	Login with admin credentials	Admin redirected to admin dashboard
6.2	Verify Admin Dashboard Access	Navigate to admin panel	Admin dashboard displayed with management options

6.3	Verify Community Management View	Click on community management	List of all communities displayed with stats
6.4	Verify Community Search (Admin)	Search for specific community	Matching communities displayed
6.5	Verify Community Privacy Filter	Filter by private/public communities	Filtered communities displayed
6.6	Verify Community Actions Modal	Click actions button on community	Modal with edit, delete, and lock options displayed
6.7	Verify Locking a Community	Lock a community via admin panel	Community locked, members cannot post
6.8	Verify Unlocking a Community	Unlock a locked community	Community unlocked, normal functionality restored
6.9	Verify Deleting a Community	Delete a community via admin panel	Community removed from database
6.10	Verify Category Management	Open category management modal	Categories displayed with add/edit/delete options
6.11	Verify Adding a Category	Create new category	Category added and visible in community filters
6.12	Verify Editing Category Details	Modify category name or description	Changes reflected in system
6.13	Verify Deleting a Category	Remove a category	Category deleted from system
6.14	Verify Community Statistics	View community stats dashboard	Total communities, members, and activity displayed

6.15	Verify User Management	Navigate to user management section	List of all users displayed
6.16	Verify Banning a User	Ban a user account	User access revoked, cannot login
6.17	Verify AI Quest Management	Access AI quest management	AI-generated quests displayed with controls
6.18	Verify Admin Profile Editing	Update admin profile details	Admin profile updated successfully
6.19	Verify Pagination Controls	Navigate through pages of data	Correct data displayed for each page
6.20	Verify Export Reports	Generate activity or sales report	Report generated and downloadable

Figure 8.6: Admin Dashboard Test

7. Leaderboard & Gamification Testing

Title: Testing Leaderboard and Scoring System

Description: Users can view rankings, compete, and track progress.

Test Case ID	**Test Case**	**Input**	**Expected Result**
7.1	Verify Global Leaderboard	Navigate to leaderboard page	Top users displayed with scores
7.2	Verify Community Leaderboard	View community-specific leaderboard	Top community members ranked
7.3	Verify Clan Leaderboard	View clan rankings	Clans sorted by total points
7.4	Verify User Ranking Update	Complete a quest	User's rank updates on leaderboard
7.5	Verify Leveling System	Earn enough XP to level up	User level increases, notification displayed

7.6	Verify Badge/Trophy Display	View user badges/achievements	Earned badges displayed on profile
7.7	Verify Leaderboard Refresh	Trigger leaderboard update	Rankings update with latest data

Figure 8.7: Leaderboard & Gamification Test

8. Upgrade & Premium Features Testing

Title: Testing Upgrade Modal and Premium Features

Description: Users can view and access premium features or upgrades.

Test Case ID	**Test Case**	**Input**	**Expected Result**
8.1	Verify Upgrade Modal Display	Click upgrade button	Upgrade modal displayed with plans
8.2	Verify Plan Comparison	View different upgrade plans	Plans displayed with feature comparisons
8.3	Verify Upgrade Selection	Select premium plan	User redirected to payment flow
8.4	Verify Premium Feature Access	Access premium-only feature	Feature accessible for premium users only
8.5	Verify Free Tier Limitations	Attempt premium action as free user	Upgrade prompt displayed

Figure 8.8: Upgrade & Premium Features Test

9. Error Handling & Edge Cases Testing

Title: Testing Error Handling and Edge Cases

Description: System handles errors gracefully and provides appropriate feedback.

Test Case ID	**Test Case**	**Input**	**Expected Result**

9.1	Verify Network Error Handling	Simulate network disconnection	Error message displayed, retry option available
9.2	Verify Invalid Input Validation	Submit form with invalid data	Validation errors displayed for each field
9.3	Verify 404 Error Page	Navigate to non-existent route	Custom 404 error page displayed
9.4	Verify Session Expiry	Wait for session to expire	User logged out, redirected to login
9.5	Verify Concurrent Updates	Two users update same data	Last update wins or conflict resolution shown
9.6	Verify Rate Limiting	Make excessive API requests	Rate limit message displayed
9.7	Verify Empty State Handling	View page with no data	Appropriate empty state message displayed
9.8	Verify Loading States	Trigger data fetch operation	Loading spinner displayed during fetch
9.9	Verify Form Submission Timeout	Submit form with server delay	Timeout message after reasonable wait time
9.10	Verify XSS Protection	Enter script tags in input fields	Scripts sanitized, not executed

Figure 8.9: Error Handling & Edge Cases Test

1. Performance & Security Testing

Title: Testing Performance and Security

Description: System performs efficiently and securely under various conditions.

Test Case ID	**Test Case**	**Input**	**Expected Result**
10.1	Verify Page Load Time	Access any page	Page loads within 3 seconds

10.2	Verify API Response Time	Make API request	Response received within 2 seconds
10.3	Verify Concurrent Users	Simulate 100+ users	System remains stable and responsive
10.4	Verify Password Encryption	Create account	Password stored as encrypted hash
10.5	Verify SQL Injection Protection	Enter SQL commands in forms	Inputs sanitized, commands not executed
10.6	Verify CSRF Protection	Attempt cross-site request	Request blocked or token validation fails
10.7	Verify Authorization Checks	Access admin route as regular user	Access denied, redirected to login
10.8	Verify Data Caching	Access same data multiple times	Cached data served, reducing load time

Figure 8.10: Performance & Security Test

9. Project Result

The outcomes of the project indicate the successful creation and deployment of LevelUp, which focuses on enhancing user engagement through gamification, community building, and AI-powered quest generation for educational and collaborative purposes.

Key Achievements:

User Authentication and Security: Comprehensive consideration has been made to the authentication mechanism with multiple login options (email/password, Google OAuth, GitHub OAuth) for users and administrators to ensure a secure and well-maintained operation of the platform. Email verification and password reset functionality provide additional security layers.

Efficient Quest Management: The platform enables users to discover, start, complete, and track both daily and weekly quests. AI-powered quest generation creates personalized challenges based on user preferences and community context, enhancing engagement and learning outcomes.

Community and Clan System: A robust system allows users to create, join, and manage communities with public or private access. Clan functionality within communities enables team-based competition and collaboration. Users can participate in community discussions, view leaderboards, and compete for rankings.

Admin Dashboard and Control: Administrators have comprehensive tools to manage communities, users, categories, and quests. The admin panel provides statistics, moderation capabilities (lock/unlock communities, ban users), and category management to maintain platform quality and safety.

Token Economy and Gamification: An effective token system enables users to earn rewards through quest completion and activities. The leveling system, badges, achievements, and leaderboards provide continuous motivation and recognition for user participation and accomplishments.

AI-Powered Features: Integration of AI assistant provides personalized quest recommendations, custom quest generation, and interactive support for users. The AI chat interface enhances user experience by offering contextual help and suggestions.

Multi-Language Support: The platform supports multiple languages (English, Spanish, French, Japanese, Chinese, Nepali, Arabic) with a seamless language switcher, making it accessible to a global audience.

Responsive Design and Accessibility: The platform is fully responsive across all devices (desktop, tablet, mobile) with dark/light theme support, ensuring optimal user experience regardless of device or preference.

10. Future Enhancements

LevelUp is already functional and operational, but there is significant potential for growth. Several features are planned to enhance the platform for both users and administrators — making it more engaging, feature-rich, and community-driven.

Planned Enhancements:

1. Quest Reviews and Ratings:

The feature of having users leave reviews and rate quests will help other community members make informed decisions when selecting challenges. This will foster community engagement and provide valuable feedback to quest creators and administrators.

2. Advanced Admin Analytics Dashboard:

An enhanced analytics dashboard will help administrators track user engagement, monitor activity trends, analyze quest completion rates, community growth, and token economy metrics. This data-driven approach will enable better platform management and strategic decision-making.

3. Enhanced Search and Filtering Options:

Improved search filters with parameters such as difficulty level, quest duration, reward range, category tags, and completion rate will enable users to easily find quests and communities that match their interests and skill levels.

4. User Posting System:

A comprehensive posting feature will allow users to create and share their own content within communities. Users can post updates, achievements, tips, guides, and engage with other members' posts through likes, comments, and shares, creating a more dynamic social experience.

5. Advanced Message Management System:

Enhanced messaging capabilities including direct messaging between users, group chats within clans, threaded conversations, message reactions, file sharing, and notification preferences. This will improve communication and collaboration among community members.

6. Loyalty and Reputation Program:

Users earning reputation points for consistent participation, quest completion, and community contributions may benefit from a loyalty program that provides exclusive badges, special privileges, early access to new features, and bonus token rewards.

7. Personalized Recommendation Engine:

AI-powered recommendations that suggest relevant quests, communities, and clans based on user behavior, interests, completion history, and skill progression to enhance user engagement and discovery.

8. Mobile Application:

Native mobile applications for iOS and Android to provide seamless on-the-go access to quests, notifications, community interactions, and real-time updates.

9. Integration with External Platforms:

Connect LevelUp with popular learning platforms, productivity tools, and social media to enable cross-platform quest completion tracking, achievements sharing, and broader community reach.

10. Gamification Events and Tournaments:**

Scheduled competitions, seasonal challenges, and community-wide events with special rewards, limited-time quests, and leaderboard prizes to maintain user excitement and engagement.

11.Conclusion

Over the development lifecycle, LevelUp has evolved from a simple concept into a comprehensive, user-friendly, and efficient gamification platform. The vision behind it was to transform learning, productivity, and community engagement into an enjoyable experience for everyone — whether you're a user seeking meaningful challenges, a community leader building engaged groups, or an administrator managing platform resources.

Features like secure multi-provider authentication, AI-powered quest generation, seamless community management, and an intuitive token economy have truly made LevelUp an exceptional experience for both users and administrators. The platform successfully bridges the gap between education, gamification, and social interaction, creating a unique ecosystem where users can grow, compete, and collaborate.

Beyond the core gamification features, which provide an engaging and rewarding experience, the platform also allows users to track their progress, compete on leaderboards, and participate in thriving communities. LevelUp's clean, responsive interface with dark/light theme support and multi-language capabilities makes it incredibly easy for users to navigate the platform and enjoy their quest completion journey.

There's tremendous potential for growth looking ahead. As plans evolve to include a mobile application, advanced messaging system, user posting features, enhanced analytics dashboard, and loyalty programs, the platform will continue to become not only more engaging but also more accessible and feature-rich. This evolution will ensure that LevelUp's ability to satisfy diverse user needs and maintain its position as a leading gamification platform remains strong.

The comprehensive testing framework outlined in this document, covering 110+ test cases across 11 modules, ensures that LevelUp maintains high standards of quality, security, and performance. From authentication flows to AI-powered features, from community management to admin controls, every aspect of the platform has been carefully tested and validated.

In the end, LevelUp is not just a regular gamification platform — it's a continuously improving ecosystem that wants to adapt, evolve, and provide an outstanding experience for everyone who seeks to level up their skills, build meaningful connections, and achieve their goals through engaging challenges and community support.

12. Annexures

LevelUp is a gamified learning and community engagement platform that makes it easy for users to develop skills, connect with like-minded individuals, and track their personal growth through interactive quests and challenges. It provides a dynamic way for learners to explore community-driven content, complete AI-generated quests, and earn experience points (XP) and rewards for their achievements. The system helps administrators manage users, moderate communities, and oversee quest generation efficiently. Users can create accounts, join or establish communities, participate in daily and weekly quests, engage in real-time chat with community members, and climb leaderboards to showcase their progress. Its intuitive design, real-time collaboration features, and AI-powered personalization make skill development and community learning engaging, motivating, and accessible for everyone.

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