Software Requirements Specification (SRS)

Classroom Key & Cycle Management System

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1. Introduction

1.1 Purpose

The purpose of this system is to provide an efficient digital solution for managing the borrowing and returning of **classroom keys** and **cycles** in an educational institution. It aims to eliminate manual processes, reduce delays, and ensure transparency.

1.2 Scope

This system enables:

- **Students to borrow cycles** using **QR codes**.
- **Class Representatives (CRs) to borrow classroom keys** for a specified duration.
- **Admins to approve borrow and return requests** for keys.
- **Automated tracking and notifications** for borrowing and returning cycles and keys.

1.3 Definitions, Acronyms, and Abbreviations

- **CR (Class Representative)**: A designated student who can borrow both cycles and classroom keys.
- **Admin**: The person responsible for approving borrow and return requests.
- **QR Code**: A machine-readable code used for cycle borrowing.
- **SRS (Software Requirements Specification)**: This document detailing system requirements.

1.4 Overview

This document describes the functional and non-functional requirements, system design, and operational aspects of the **Classroom Key & Cycle Management System**.

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2. Functional Requirements

2.1 User Roles & Permissions

Role	**Permissions**
Student	Borrow and return cycles
CR (Class Representative)	Borrow and return cycles & classroom keys
Admin	Approve/reject key borrowing & return requests

F1: Functional Requirements for Students

Description: Students can borrow and return cycles and receive notifications related to their activities.

F1.1 User Authentication

- F1.1.1 Register using a unique email and password.
- F1.1.2 Login using credentials or NITC mail ID.
- F1.1.3 Reset password if required.

F1.2 Cycle Borrowing and Returning

- F1.2.1 Scan a QR code to borrow a cycle.
- F1.2.2 Verify cycle availability before borrowing.
- F1.2.3 Record borrow time and expected return time.
- F1.2.4 Return a cycle by scanning a QR code.
- F1.2.5 Update cycle status upon return.
- F1.2.6 Receive notifications for borrowing time limits.

F1.3 Notifications and Tracking

- F1.3.1 Receive notifications when a borrow request is approved or rejected.
- F1.3.2 Receive reminders before the return due time.
- F1.3.3 View borrowed cycle history.

F2: Functional Requirements for Class Representatives (CRs)

Description: CRs can manage classroom key borrowing, approvals, and transfers.

F2.1 Key Borrowing and Returning

- F2.1.1 Request a key for a specified duration.
- F2.1.2 Verify key availability before borrowing.
- F2.1.3 Submit a return request for keys.
- F2.1.4 View key borrowing history.

F2.2 Request Approval and Rejection

- F2.2.1 Approve or reject classroom key borrow requests.
- F2.2.2 Notify students of approval or rejection decisions.

F2.3 Key Transfers Between CRs

- F2.3.1 Request a key transfer from another CR.

- F2.3.2 Approve or reject key transfer requests.
- F2.3.3 Update key ownership status upon approval.

F2.4 Notifications and Tracking

- F2.4.1 Receive notifications for key borrow requests.
- F2.4.2 Receive reminders for due returns.
- F2.4.3 Track borrowed classroom keys.

F3: Functional Requirements for Admins

Description: Admins oversee system users, roles, and tracking borrowed assets.

F3.1 User Authentication & Management

- F3.1.1 Enforce role-based access (Student, CR, Admin).
- F3.1.2 Support multi-factor authentication if required.
- F3.1.3 Manage users (add, update, remove).
- F3.1.4 Assign and update roles.

F3.2 System Monitoring and Reports

- F3.2.1 Maintain a list of currently borrowed cycles and keys**.**
- F3.2.2 Display borrowing history for each user.
- F3.2.3 Allow filtering and searching of borrowing records.
- F3.2.4 Generate reports on borrowed items.

F3.3 Notifications and Oversight

- F3.3.1 Receive notifications when borrow/return requests are submitted.
- F3.3.2 Configure notification preferences for users.

3. Non-Functional Requirements

3.1 Performance Requirements

- The system should handle **100+ concurrent users**.
- QR code scanning should take **less than 2 seconds**.

3.2 Security Requirements

- JWT authentication for **secure user login**.
- Role-based access control for **Students, CRs, and Admins**.
- **Encrypted QR codes** to prevent forgery.
- **Usage encryption to store sensitive user data.**
- **Enforce role-based access control (RBAC).**
- **Only Admins can modify roles.**

3.3 Usability Requirements

- The system should have a **simple UI for students & CRs**.
- Admin dashboard should display **all pending requests clearly**.
- Mobile responsiveness for **easy access from phones**.

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4. System Design

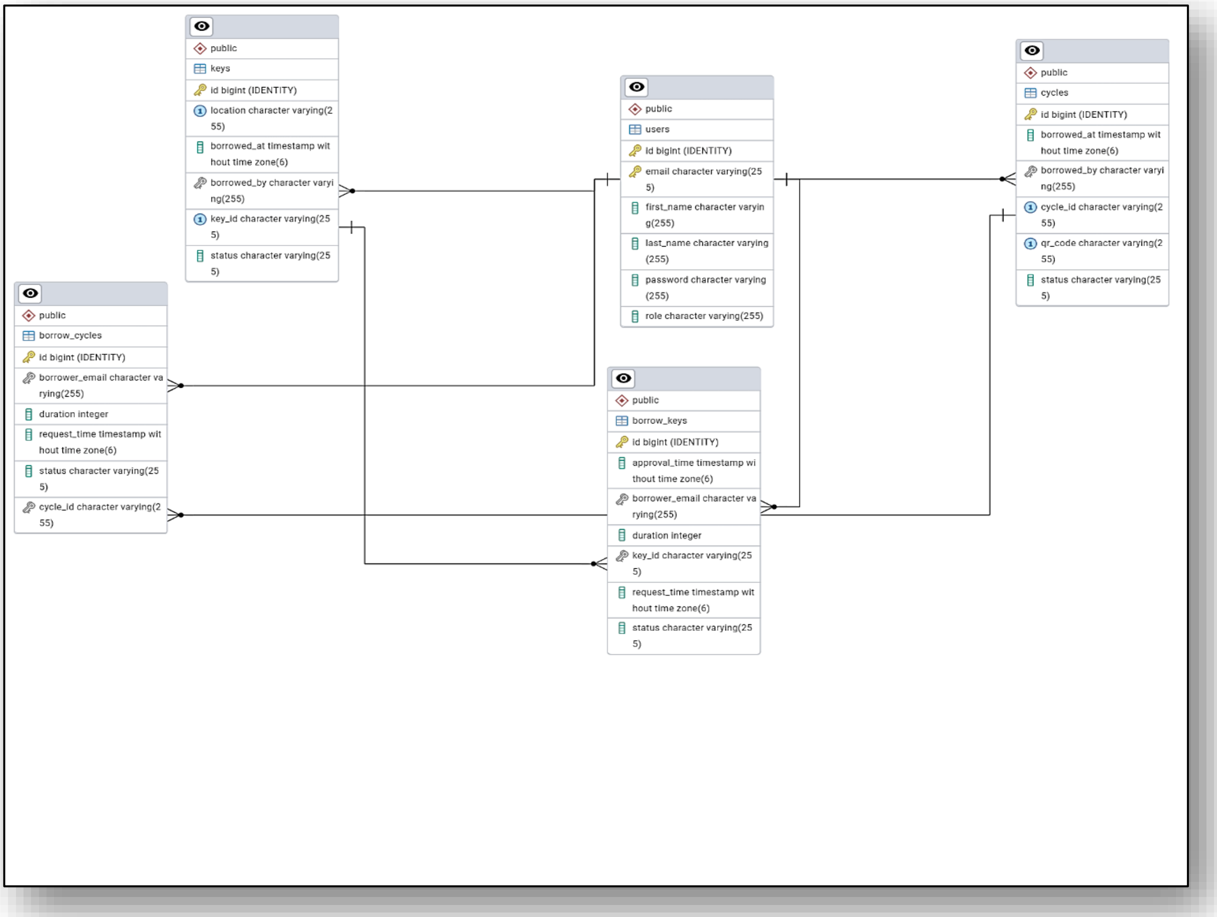
4.1 Technologies to be used

- **Frontend:** Angular (TypeScript, Bootstrap, QR Code Scanner)
- **Backend:** Spring Boot (REST APIs, JWT Authentication)
- **Database:** PostgreSQL (Stores users, keys, cycles, transactions)
- **Caching:** Redis (For real-time updates & quick retrieval)

4.2 Database Design

Tables

1. **Users** (id,email,firstName,lastName, role,EncryptedPassword)
2. **Cycles** (id, cycleId, qrCode, status, borrowedBy)
3. **ClassroomKeys** (id, keyId, status, borrowedBy)
4. **KeyRequests** (id, keyId, borrowerEmail, duration, status)
5. **CycleRequests** (id, cycleId, borrowerEmail, status)


public
keys
id bigint (IDENTITY)
location character varying(255)
borrowed_at timestamp without time zone(6)
borrowed_by character varying(255)
key_id character varying(255)
status character varying(255)
public
users
id bigint (IDENTITY)
email character varying(255)
first_name character varying(255)
last_name character varying(255)
password character varying(255)
role character varying(255)
public
cycles
id bigint (IDENTITY)
borrowed_at timestamp without time zone(6)
borrowed_by character varying(255)
cycle_id character varying(255)
qr_code character varying(255)
status character varying(255)
public
borrow_cycles
id bigint (IDENTITY)
borrower_email character varying(255)
duration integer
request_time timestamp without time zone(6)
status character varying(255)
cycle_id character varying(255)
public
borrow_keys
id bigint (IDENTITY)
approval_time timestamp without time zone(6)
borrower_email character varying(255)
duration integer
key_id character varying(255)
request_time timestamp without time zone(6)
status character varying(255)

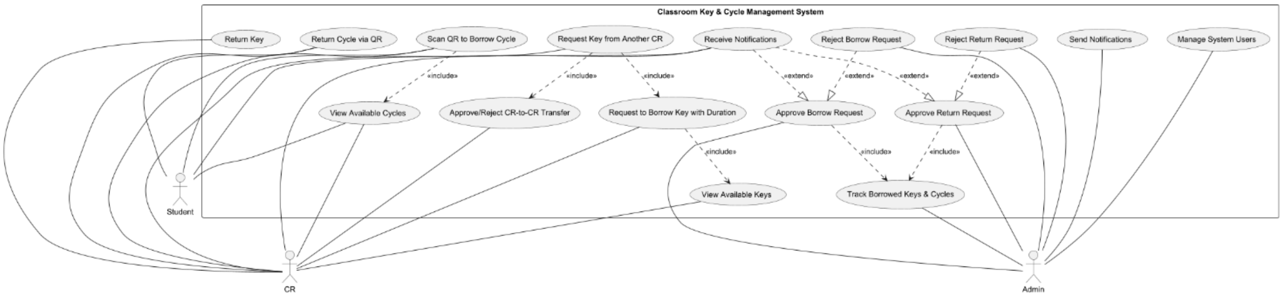
5. Assumptions & Constraints

- A user **can only borrow one cycle at a time**.
- CRs must **specify a time duration** when borrowing keys.
- The system must **automatically mark keys as "Available"** after the borrow duration expires.

6. Future Enhancements

- **Auto-reminders for cycle returns**.
- **Integration with college ID cards** for authentication.
- **Mobile App version** for quick QR scanning.

7.USE CASE DIAGRAM



Actors (Users):

1. **Student** – A user who borrows and returns cycles.
2. **CR (Class Representative)** – A user who manages borrow/return requests and transfers keys.
3. **Admin** – A superuser who oversees the entire system, including user management.

Use Cases and Relationships:

Each oval represents a **use case** (a system functionality), and the lines indicate which actor interacts with each use case.

1. Student (User) Actions

A student interacts with the system to borrow and return cycles and receive notifications.

Cycle Borrowing and Returning

- **Scan QR to Borrow Cycle → The student can scan a QR code on the cycle to borrow it.**
- **View Available Cycles → The student can check available cycles before borrowing.**
- **Return Cycle via QR → The student can scan a QR code to return the borrowed cycle.**

- **Receive Notifications → The system sends alerts for borrowing approvals, due return reminders, and overdue cycles.**

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2. Class Representative (CR) Actions

A CR (Class Representative) has all the actions of a student and additional privileges to manage classroom keys.

Cycle Borrowing and Returning *(Same as Students)*

- **View Available Cycles**
- **Scan QR to Borrow Cycle**
- **Return Cycle via QR**

Key Borrowing and Returning

- **View Available Keys → The CR can check which classroom keys are available.**
- **Request to Borrow Key with Duration → The CR can request a key for a specified time.**
- **Return Key → The CR can return a key after use.**
- **Receive Notifications → The CR is notified of key borrow approvals, return reminders, and overdue keys.**

Request Transfers Between CRs

- **Request Key from Another CR → A CR can request a key transfer from another CR.**
- **Approve/Reject CR-to-CR Transfer → The recipient CR can approve or reject a key transfer request.**

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3. Admin Actions

An Admin has full control over the system, including managing users and tracking borrowed items.

Request Approval and Rejection

- **Approve Borrow Request → Admin can approve requests for keys and cycles.**
- **Reject Borrow Request → Admin can reject borrow requests if needed.**
- **Approve Return Request → Admin can approve cycle or key returns.**

- **Reject Return Request → Admin can reject return requests if conditions are not met.**

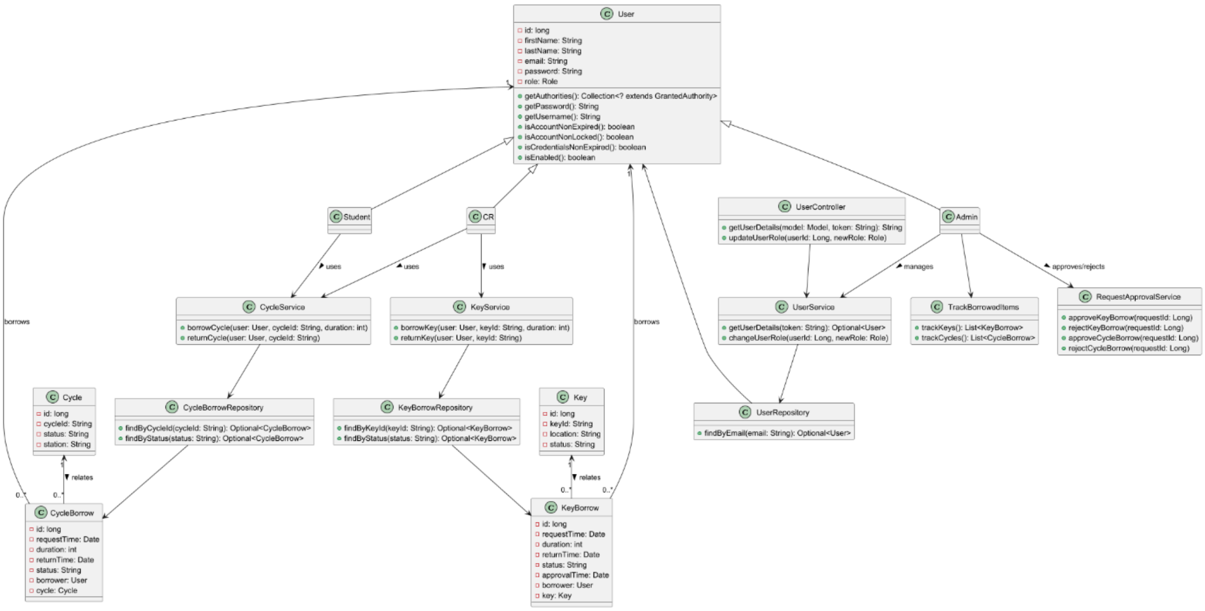
Tracking and Notifications

- **Track Borrowed Keys & Cycles → Admin can view all active borrow records.**
- **Send Notifications → The system sends alerts for approvals, due returns, and user updates.**

System Management

- **Manage System Users → Admin can add, update, and remove users, and assign roles (Student, CR, Admin).**

CLASS DIAGRAM


User
id: long
firstName: String
lastName: String
email: String
password: String
role: Role
getAuthorities(): Collection<? extends GrantedAuthority>
getPassword(): String
getUsername(): String
isAccountNonExpired(): boolean
isAccountNonLocked(): boolean
isCredentialsNonExpired(): boolean
isEnabled(): boolean
Student
CR
UserController
getUserDetails(model: Model, token: String): String
updateUserRole(userId: Long, newRole: Role)
Admin
uses
uses
uses
manages
approves/rejects
borrows
borrows
CycleService
borrowCycle(user: User, cycleId: String, duration: int)
returnCycle(user: User, cycleId: String)
KeyService
borrowKey(user: User, keyId: String, duration: int)
returnKey(user: User, keyId: String)
UserService
getUserDetails(token: String): Optional<User>
changeUserRole(userId: Long, newRole: Role)
TrackBorrowedItems
trackKeys(): List<KeyBorrow>
trackCycles(): List<CycleBorrow>
RequestApprovalService
approveKeyBorrow(requestId: Long)
rejectKeyBorrow(requestId: Long)
approveCycleBorrow(requestId: Long)
rejectCycleBorrow(requestId: Long)
Cycle
id: long
cycleId: String
status: String
station: String
CycleBorrowRepository
findByCycleId(cycleId: String): Optional<CycleBorrow>
findByStatus(status: String): Optional<CycleBorrow>
KeyBorrowRepository
findByKeyId(keyId: String): Optional<KeyBorrow>
findByStatus(status: String): Optional<KeyBorrow>
Key
id: long
keyId: String
location: String
status: String
UserRepository
findByEmail(email: String): Optional<User>
relates
relates
1
1
1
1
0..*
0..*
0..*
0..*
CycleBorrow
id: long
requestTime: Date
duration: int
returnTime: Date
status: String
borrower: User
cycle: Cycle
KeyBorrow
id: long
requestTime: Date
duration: int
returnTime: Date
status: String
approvalTime: Date
borrower: User
key: Key

Class Overview:

1. User Hierarchy

- User: The base class representing all system users, including students, class representatives (CRs), and admins.
- Student: A subclass of User that can borrow and return cycles using CycleService.
- CR (Class Representative): A subclass of User that can borrow and return both keys (KeyService) and cycles (CycleService).

- Admin: A subclass of User that manages users, approves/rejects borrow requests, and tracks borrowed items.

2. Borrowing Entities

- KeyBorrow: Represents a key borrowing request with attributes such as keyId, requestTime, duration, and status.
- CycleBorrow: Represents a cycle borrowing request with attributes such as cycleId, requestTime, duration, and status.

3. Services and Repositories

- KeyService: Manages key borrowing and returning.
- CycleService: Manages cycle borrowing and returning.
- KeyBorrowRepository: Handles database operations for key borrowing.
- CycleBorrowRepository: Handles database operations for cycle borrowing.
- UserRepository: Manages user authentication and retrieval.

4. Request Approval & Tracking

- RequestApprovalService: Allows admins to approve or reject borrow requests for keys and cycles.
- TrackBorrowedItems: Enables admins to track currently borrowed cycles and keys.

5. Controllers & User Management

- UserController: Handles user-related requests, including authentication and role management.
- UserService: Provides business logic for user authentication and role changes.

Version History

Version	Date	Prepared By	Reviewed By	Description
1.0	18-Feb-2025	N. Vivek Teja	K. NAVANEETH	Initial Draft
1.0.1	19-Feb-2025	N. Teja	N. Vivek Teja	Added Use case Model and Entity Relationship Diagram

Version	**Date**	**Prepared By**	**Reviewed By**	**Description**
1.1	26-Feb-2025	N. Teja	N. Vivek Teja	Added Class Diagram and Made changes in Use case Model and Functional Requirements according to the comments made by evaluator