**Smart School Lab Manager – IoT Lab**

**📑 Database Design Report**

**Date:** May 14, 2025  
**Prepared by:** Albert A Allen- SWE Team  
**Project Phase:** Week 1 – Planning & Setup  
**File:** design/db-schema.md

**1. 🎯 Purpose of This Document**

This document outlines the **Entity-Relationship Diagram (ERD)** and rationale behind the **database schema** for the Smart School Lab Manager – IoT Lab system. The design supports core features including:

* Device control and scheduling
* User management with role-based access
* Logging and monitoring of usage
* Notification of system misuse or abnormal behavior

**2. 🧱 Key Entities (Tables)**

| **Entity** | **Description** |
| --- | --- |
| users | Stores user accounts with roles such as Admin, Teacher, or Student |
| devices | Represents lab equipment like PCs, projectors, fans, etc. |
| logs | Tracks user interactions with devices (on/off actions, timestamps) |
| schedules | Stores automation rules (e.g., power off at 5PM) |
| notifications | Logs abnormal usage or violations for review |
| device\_access | Manages permissions (who can control what) |

**3. 🔗 Entity Relationships**

| **Relationship** | **Description** |
| --- | --- |
| One user ➡️ many logs | Tracks multiple actions per user |
| One user ➡️ many schedules | Users can define automation rules |
| One device ➡️ many logs | Each device has multiple usage records |
| One device ➡️ many notifications | Alerts tied to a specific device |
| Many-to-Many: users ↔️ devices | Managed via device\_access table |

**4. 🧬 Schema Overview**

**users**

| **Field** | **Type** | **Description** |
| --- | --- | --- |
| id | UUID | Primary key |
| name | VARCHAR | Full name |
| email | VARCHAR | Unique login |
| password | HASH | Encrypted password |
| role | ENUM | 'admin', 'teacher', 'student' |
| created\_at | TIMESTAMP | Date joined |

**devices**

| **Field** | **Type** | **Description** |
| --- | --- | --- |
| id | UUID | Primary key |
| name | VARCHAR | Device label (e.g., PC1) |
| type | VARCHAR | PC, projector, fan, etc. |
| status | BOOLEAN | On/off |
| location | VARCHAR | Lab room (e.g., Lab A) |

**logs**

| **Field** | **Type** | **Description** |
| --- | --- | --- |
| id | UUID | Primary key |
| user\_id | UUID (FK) | Linked to users.id |
| device\_id | UUID (FK) | Linked to devices.id |
| action | ENUM | 'on', 'off', 'denied' |
| timestamp | TIMESTAMP | When action occurred |

**schedules**

| **Field** | **Type** | **Description** |
| --- | --- | --- |
| id | UUID | Primary key |
| user\_id | UUID (FK) | Owner of the rule |
| device\_id | UUID (FK) | Device to control |
| action | ENUM | 'on', 'off' |
| time | TIME | When to trigger |
| recurrence | VARCHAR | e.g., "daily", "Mon–Fri" |

**notifications**

| **Field** | **Type** | **Description** |
| --- | --- | --- |
| id | UUID | Primary key |
| device\_id | UUID (FK) | Linked to device |
| message | TEXT | Violation or alert |
| severity | ENUM | 'low', 'medium', 'high' |
| timestamp | TIMESTAMP | Alert time |

**device\_access**

| **Field** | **Type** | **Description** |
| --- | --- | --- |
| id | UUID | Primary key |
| user\_id | UUID (FK) | User granted access |
| device\_id | UUID (FK) | Device assigned |
| can\_control | BOOLEAN | Permission flag |

**5. 📸 ERD Visual Snapshot**

*Refer to the erd.png or erd.pdf file in the /design folder for a full visual layout of the schema.*  
*Example path: /design/erd.png*

**6. 🧠 Rationale & Best Practices**

* **Normalization**: Database is normalized to 3NF to reduce redundancy and ensure scalability.
* **Security**: Passwords are encrypted. Access control is managed at both user and device levels.
* **Scalability**: Tables are structured to support adding IoT devices, users, or new features without structural overhaul.
* **Auditing**: The logs and notifications tables support full monitoring and traceability.

**7. 📌 Next Steps**

* Implement database schema in PostgreSQL (or chosen DBMS).
* Connect backend models/controllers to these tables.
* Test CRUD operations and role-based permissions.