Project and Seminar

2024/2025 - 2nd Semester

Bachelor in Computer Engineering and Informatics

Remote Lab

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Introduction

The design, development, implementation, and finally, the validation of digital systems require, in addition to simulators, the use of hardware to verify their implementations in real devices. In the current teaching paradigm, in which face-to-face time is reduced and remote and autonomous work is increased, it is necessary to create alternatives to the current model.

The Remote Lab project aims to provide a virtual lab with access to remote hardware. This lab consists of a web application running on an embedded system. The web application, accessed via a website, aims to provide a dashboard where users can join a laboratory. This is where users can control the remote hardware. A hierarchy system will be implemented to provide different roles, each with their own permissions relative to how users can browse the information provided by the web application.

Requirements

Database

A database will be used to store the information of the web application. This includes the user's information, the laboratories' information and the hardware's information.

- User information storage
- Laboratory configurations and schedules
- Hardware specifications and status

Web API

The web API will be a RESTful API that will be used to communicate with the web application. It will be responsible for the communication with the database and the hardware.

- Authentication and authorization endpoints
- Laboratory management endpoints
- Real-time data communication

Authorization

The authorization will be implemented with a RBAC (Role-Based Access Control) system. This will allow the user to have different roles with different permissions:

- Student
  - Enter a laboratory when the professor allows it
  - Configure, view and control the hardware on the laboratory
  - Schedule laboratory sessions through the calendar
- Professor
  - Create, read, update and delete (CRUD) laboratories
  - Invite students to join the platform through a unique code
  - Invite students to join a laboratory

  - See the laboratories' schedules and usage
  - Create, read, update and delete (CRUD) hardware on the laboratory
- Administrator
  - Has all the other roles' permissions
  - Create, read, update and delete (CRUD) users

Authentication API

The authentication API will be a separate RESTful API that will be used to authenticate the user.

Web Application

The web application will have a dashboard where the user can join a laboratory. This is where the user can control the remote hardware.

- User-friendly interface
- Real-time hardware monitoring
- Session management

Hardware Integration

There will be a hardware integration module that will be responsible for the integration of the hardware into the web application.

System Architecture

The system architecture consists of multiple interconnected components that work together to provide the remote laboratory functionality.

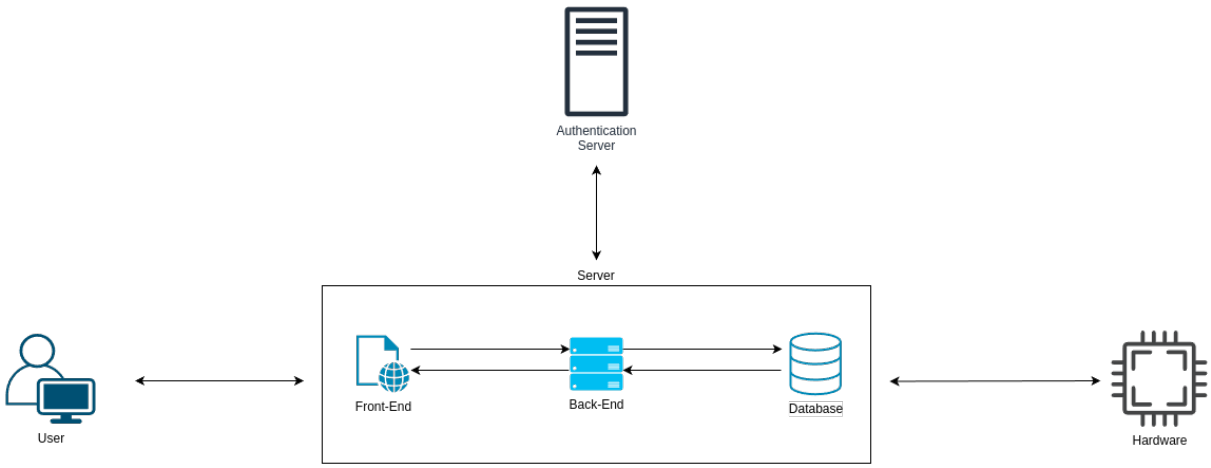

Figure 1: System Architecture Overview

Timeline

The project will be developed following the timeline shown in Figure 2, which outlines the main phases and milestones of the development process.

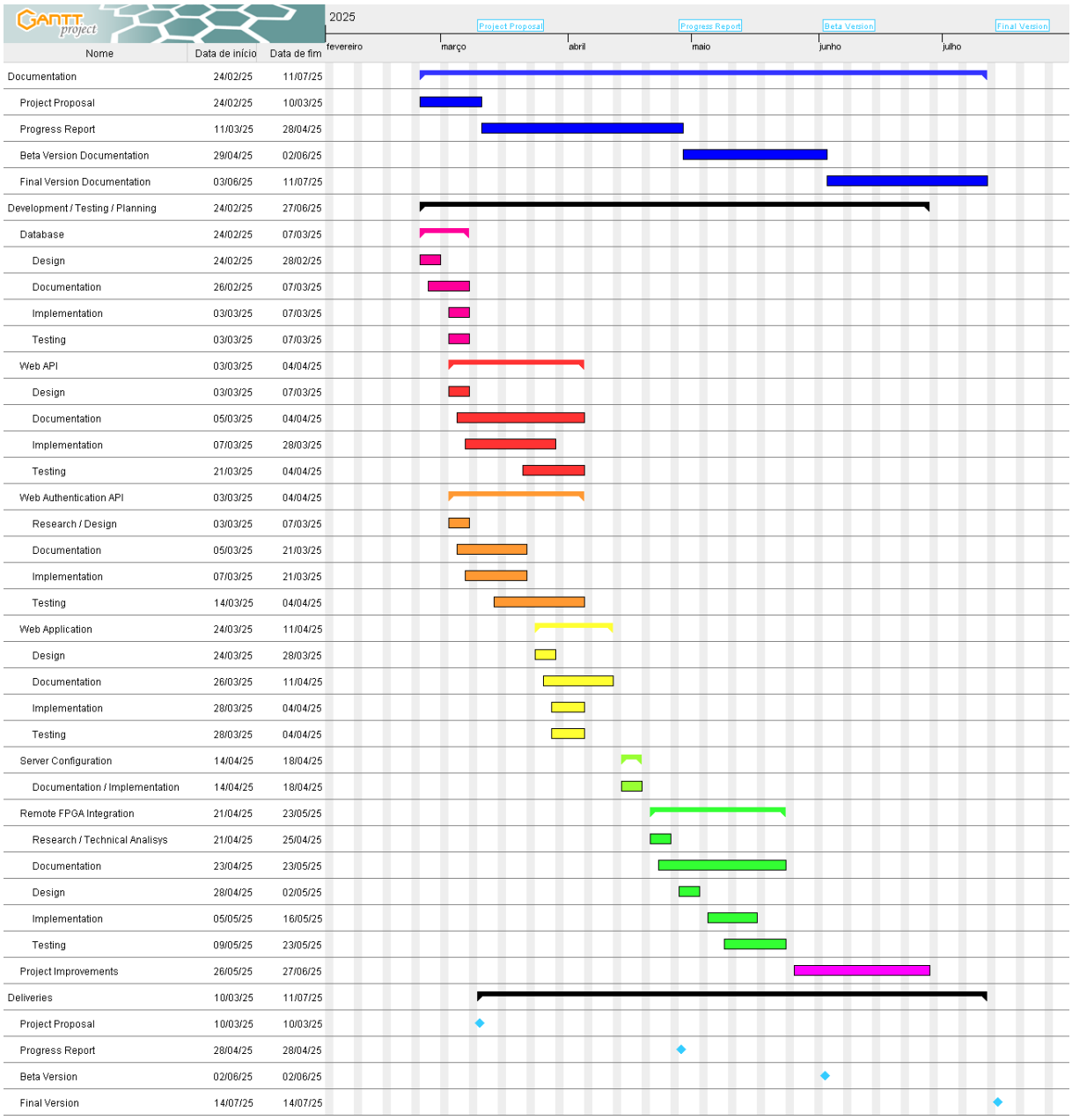

Figure 2: Project Timeline and Milestones

1 User Journey

1.1 General Account Creation

1. The user receives an invite code.
2. The user goes to the account creation page.

3. The user enters the invite code.
4. The user creates an account.

1.2 General Login

1. The user goes to the login page.
2. The user enters their email and password.
3. The user logs in.