University of Science and Technology of Ha Noi
Department of Information and Communication Technology

Group Project Report

USTH Connect

Integrated app for university life assistant and student networking

by

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1 Introduction

1.1 Context and Motivation

University life presents numerous challenges, from navigating academic responsibilities to establishing meaningful connections. This app is designed to serve as a supportive platform, enabling students to better manage their university experience while fostering a sense of community and enhancing overall engagement.

1.2 Process Flow

This section outlines the comprehensive process flow of University Life Assistant and Student Networking Application, detailing the progress from system construction to feature integration, including authentication with Spring Boot, Google Calendar integration, MapBox integration, Moodle resource fetching, real-time notifications, and the StudyBuddy matching system with machine learning algorithms.

1.2.1 System Construction

This section details the process of building the system. It covers the setup of hardware components, the configuration of software environment, the creation of the application's software components, and initial testing to make sure everything works smoothly.

1.2.1.1 Hardware Setup

The hardware components required for the system include:

- **Development Machines:** Computers used for developing and hosting the backend services and databases (Spring Boot and PostgreSQL).
- **User Devices:** Smartphones or Virtual Devices running the Android app to access features such as Google Calendar, MapBox maps, and Moodle resources.
- **Networking Equipment:** Tailscale VPN for secure and reliable communication between user devices and the backend server.

1.2.1.2 Software Environment Configuration

The hardware components required for the system include:

- **Operating System:** Window was used for hosting the backend services and database, while Android was the main platform for the app.
- **Database:** PostgreSQL was installed and configured as the relational database management system to store user information, calendar events, location data, and StudyBuddy profiles.

- **Backend Framework:** Spring Boot was deployed to manage REST API endpoints and handle authentication, authorization, and data synchronization.
- **Mobile Development Tools:** Android Studio served as the primary IDE for developing the Android application, integrating Java and libraries such as Retrofit and MapBox SDK.

1.2.1.3 Application Software

The application software consists of several key modules:

- **Authentication and Authorization Module:** Implements JWT-based authentication and Role-Based Access Control (RBAC) to manage access permissions for ADMIN and USER roles.
- **Google Calendar Integration Module:** Fetches event data from Google Calendar, detects changes, and delivers notifications to the user through the mobile application.
- **MapBox Integration Module:** Stores and serves latitude and longitude coordinates of campus locations to dynamically render maps within the application.
- **Moodle Resource Module:** Interacts with Moodle APIs to retrieve course-related resources such as slides, source code, and PDFs.
- **StudyBuddy Matching Module:**
  - Collects user profile data (e.g., interests, personality).
  - Utilizes a machine learning recommendation system to suggest suitable matches based on shared interests and compatibility.
  - Incorporates a chat feature for text-based communication between matched users.
  - Enables audio calls between users through the Linphone library, which provides SIP-based VoIP functionality for real-time communication.
- **Notification System:** Facilitates real-time notifications for calendar event updates, and received call.

1.2.1.4 Initial Testing

Initial testing was performed to verify the functionality and integration of all components:

- **Hardware Testing:** Verified the correct installation and operation of servers, development machines, and networking equipment, utilizing a Tailscale VPN for secure connections.
- **Software Testing:** Ensured proper configuration and performance of the operating system, PostgreSQL database, and Spring Boot services.

- **Integration Testing:** Validated the seamless interaction between backend APIs and mobile app features, including:
  - Google Calendar synchronization.
  - MapBox map rendering.
  - Moodle resource retrieval.
  - StudyBuddy matching functionality.
  - Linphone-based audio calling capabilities.

1.2.2 Machine Learning Model Integration and Model Training

1.3 Project Objectives

The primary objective of this project is to develop a mobile application designed to streamline the management of university systems. This includes functionalities such as monitoring students' grades, organizing study schedules, and, most notably, introducing a feature that leverages machine learning algorithms to connect students with shared academic interests or hobbies. This advanced approach aims to foster meaningful communication and collaboration, enabling students to engage and study together beyond the classroom.

1.4 Desired Outcomes

1.5 Structure of Thesis

The thesis will be structured as follows:

- **Part I: Introduction**
  Provide a general introduction to the thesis, including an overview of the project, its objectives, and the scope of the work.

- **Part II: Requirement Analysis**
  Lists all the tools, techniques, and system requirements used in the project. It includes both functional and non-functional requirements, as well as desired functionalities.

- **Part III: Methodologies**
  System architecture, database design, and implementation details of various features, illustrated with sequence diagrams.

- **Part IV: AI Model Analysis and Training**
  Analysis and training of AI models for recommend system for study buddy matchmaking, including datasets and model development, with (Model Name) integration.

- **Part V: Results and Discussions**

  Summarizes the implementations and achievements of the system. It reflects on how the objectives were met and provides a summary of the project's outcomes.

- **Part VI: Conclusion and Future Work**

1.6 Related works

In this part we will cite some related works/papers that we used mainly for this project. We also summarize the content of these resources.

2 Requirement Analysis

2.1 System requirements

2.1.1 Functional Requirements

2.1.2 Non-functional Requirements

2.1.3 Desired Functionalities

2.2 Use Case

2.2.1 Use Cases Diagram

2.2.2 Use Case Characteristics

2.3 Use Case and Scenario Description

3 Methodologies

3.1 System Architecture

3.2 Database Design

3.3 Use Case Implementation

4 AI Model Analysis and Training

5 Results and Discussion

5.1 Results

5.1.1 Mobile App Results

In this part we can have the demo for each feature of the app.

5.1.2 Machine Learning Results

In this part we will show the result of the clustering algorithm, using the evaluation metrics that we mentioned in the previous section.

5.2 Discussion

6 Conclusion & Future Work

6.1 Conclusion

6.2 Future Work