KINGDOM OF SAUDI ARABI
Ministry of Education
Taibah University
College of Computer Science and Engineering
(Female Section)

المملكة العربية السعودية
وزارة التعليم

جامعة طيبة
كلية علوم وهندسة الحاسب الآلي
(قسم الطالبات)

CS buddy: An Assistant for Undergraduate Computer Science Students

Graduation Project (1)

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CS BUDDY

A project submitted in partial fulfilment of the requirements for the degree of Bachelor of Science (Computer Science)

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Abstract

Many students in our college, the College of Computer Science and Engineering, get lost looking for reliable resources or searching for clarification of ambiguous terminologies. They spend a lot of effort and time obtaining references and books for studying subjects. One of the students' issues is that they have difficulty finding their instructors' emails, and some students find it difficult to ask for help from others. Moreover, one of the drawbacks that the students face is getting rid of books after finishing their semester instead of dealing with them in a better way. Also, some students prefer to study in study groups, which sometimes lack proper coordination. These issues must be addressed. Our application, CS buddy, aims to provide solutions to the problems mentioned above in one place to save time, effort, and money.

The CS buddy uses a recommender system to personalize the home page for each user according to the students' schedules and provide reliable resources for the courses. In addition, the application allows students to deal with their books efficiently by offering them for sale, lending, or donation. Furthermore, the application provides a space where students can post announcements for study groups to inform other students interested in joining. The project's primary purpose is to help students easing up their academic life.

Keywords Personalization; Recommender system; Books; Emails; Study groups.

Acknowledgement

First, thank God for helping us complete this project. This project could not have been done without the hard work of our group members. We want to send our sincerest appreciation to our supervisor Dr. Modhawi Alotaibi for her patience, guidance, and support during this semester.

Lastly, thanks to our families and friends for surrounding us with love and support. Thanks to the smallest, beautiful things that help us keep going and dream big. Thanks for the Art, Music, and Books and who made them.

Table of Content

List of Figures

List of Tables

List of Abbreviations

COVID-19	Coronavirus Disease 2019
E-Books	Electronic Books
E-Learning	Electronic Learning
CS	Computer Science
CF	Collaborative Faltering
CBR	Content-Based Recommendation
CBF	Content-Based Filtering
iOS	iPhone Operating System
EAS	Education Access Scheme
ER	Entity-Relationship Diagram
UML	Unified Modeling Language
UI	User Interfaces
UX	User Experience

Chapter 1: Introduction

Introduction

In university life, there are many difficulties and problems that students face daily. These problems may be academic, social, or psychological. These problems may affect the student's academic performance. One of the causes of these problems is that the students are not satisfied with the provided information in the classrooms, which decreases academic performance and increase frustration and anxiety for the students. The students may have a preferred method and time to study. We have noticed that in the pandemic and online education the performance of many students has improved. The reason is the students had become a self-directed learner at the appropriate time for them [1]. Searching and investigating information from external sources may be costly and available platforms provide courses with individual subscription.

One main problem from a social perspective in the university community is beneficial to the students to build relations with each other specially to exchange resources and information and this matter may pressure students who are introverts.

There is a need to make the academic life of the university students simpler by applying digitalized methods. As George Eliot said, "What do we live for, if it is not to make life less difficult for each other".

Problem Definition

Most students during their studying years at university, especially freshmen, face many problems and difficulties finding resources and academic information about courses or other data because they do not know where or how to get them. Students need a place that provides all facilities that help them to improve their academic performance. However, most popular platforms that provide reliable resources require buy for subscription. We summarized the common problems the students have into these problems:

- The lack of reliable resources, and time-consuming to find them.
- A variety of ambiguous terms in computer science make students get confused about them.
- Reaching courses instructors' emails easily.
- Introverts' main problems is that they find it difficult to ask for help in person.
- Many students cannot afford books for their courses.
- Many students need help to understand the unclear part of the course in person.

Project Objectives

Generally, this project aims to ease up the CS students' academic life by providing the following:

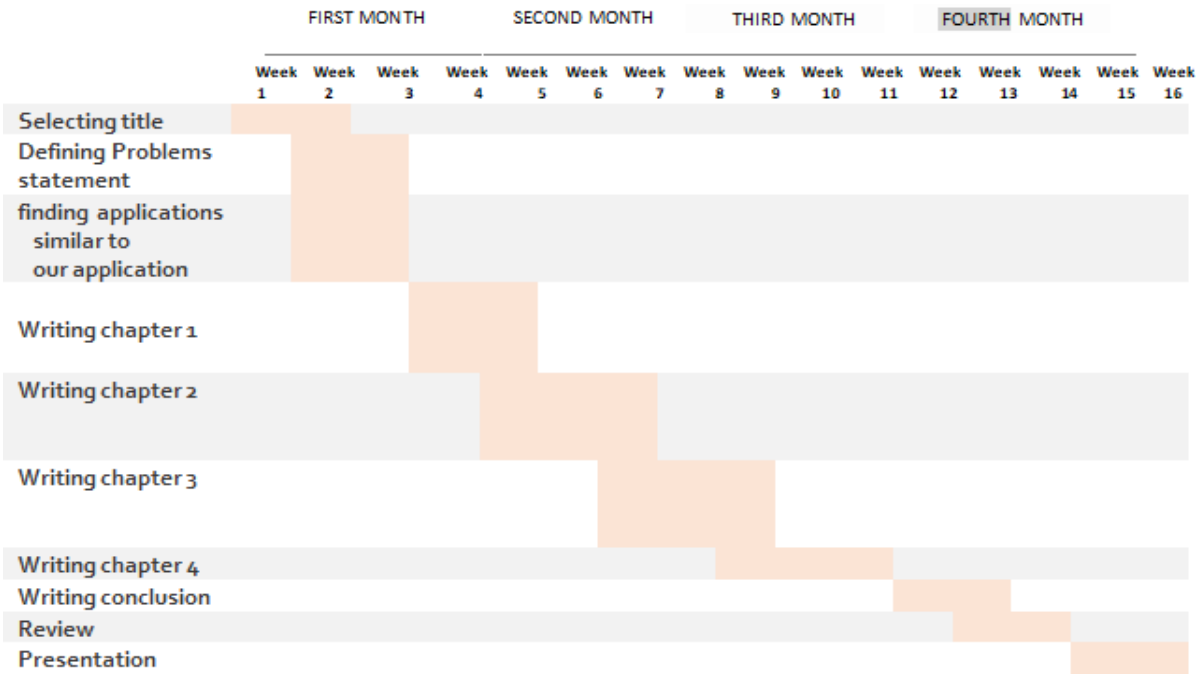
- Centering all resources and references of computer science's lectures as websites, eBooks, and PDFs in one place.
- Allowing the students to search for ambiguous terms and finding in which courses they are mentioned.
- Providing a brief description of each course to describe the general concept of the course to make it clear to students.
- Faster access to instructor's emails.
- Advertising space for exchanging books.
- Providing a private conversation between students to share services.
- Providing a suitable environment for introverts.
- Advertising space for a study group or for volunteering tutoring.

Project Scope

The application will focus on the CS students at Taibah University. Especially the students who need more resources and need their time to be saved, and who are introverts and have difficulties to ask.

Project Timeline

Table 1.1: Shows the time required for each task.



Document Organization

The project contains five chapters. These chapters are organized to return the scientific steps toward our main objective and show the main phases of developing our application CS buddy. The contents' description of each chapter is given in the following:

- Chapter 1 introduces the main idea of the application. Then, it describes the problem definition, determines the project objective, the application's scope, and puts a timeline for each chapter.
- Chapter 2 gives an overview of literature review and background describing the approaches and techniques needed for CS buddy.
- Chapter 3 analyzes the survey and describes the requirements elicitation, functional and non-functional requirements, user requirements or domain requirements, requirements specification, and methodologies.
- Chapter 4 elucidates different design aspects, architectural design, object-oriented design, user interface design, and modeling data.

Chapter 2: Literature review

2.1 Introduction

In this chapter, the essential concept and techniques in the context of this work are explained. Section 2.2 is divided into two sections. First, we overview the impact of COVID-19 on education and the importance of including technology in learning. In the second section, we overview personalization techniques and the recommender system and its approaches. Section 2.3 is divided into two subsections. First, we discuss existing applications that share common information about E-learning technology. In the second subsection, we compare the similarities and differences between our work and other applications.

2.2 Background

We address the impact of COVID-19 on education and discuss intensely the personalization of recommender system approaches.

2.2.1 Impact of Coronavirus Pandemic on Education.

We live in the era of technology. So many things in our lives get done with technology, for instance, airplane tickets, appointment booking in the hospital, ordering food, etc. In our lives, technology is integrated in the smallest to the most significant things. E-learning is necessary especially in the changes in higher education to move towards knowledge [2]. We, as students, cannot ignore that e-learning is developing because of the pandemic of covid-19.

The outbreak of the Corona pandemic in the world has revealed many gaps in different sectors, such as the gap in education worldwide. The high rate of spread of the epidemic led to many problems, including losing many teachers their jobs, closure of many schools around the world, and losing many students their educational opportunities. Educational institutions that have included the use of emerging technologies in their systems before the outbreak of COVID- had a comparative advantage over those who do not [3].

The use of technologies in education provides students and teachers with many advantages, including:

- **Students:**
    - Easing communication with teachers.
    - Watching the lectures at the appropriate times.
    - Organizing schedules is easier and faster.
    - Communicating with students in the class and sharing information.
    - Increasing computer skills.
    - Flexibility in assignment delivery times so that students can submit assignments from their homes.
- **Teachers:**
    - Communicating with students in an easier and faster way.
    - Explaining information using techniques makes it easier for the teacher to present the content in a simpler manner.
    - Recording lectures at times suitable for the teacher and then uploading them to the students.
    - Correcting exams and monitoring grades automatically.

2.2.2 Personalization

Personalization is the process of performing a tailor-made platform in the form of information, platform layout, and structure [4]. The recommendation is a part of personalization but not vice versa. For example, YouTube might suggest related videos based on other YouTube users' watching. This is a recommendation. A personalization, for example, in a restaurant might suggest a table by the window based on a previous booking you have made. It is based on the individual's specific preferences and not a broad algorithm. The more you know about a person, not just their viewing preferences, the better. In other words, a recommendation is often built around items, whereas personalization is built around people [5]. Intelligent techniques are used in different stages of electronic learning systems to achieve personalization. Other e-learning platforms create learners' profiles and define paths of learning. The recommending system is responsible for proposing individual learning paths for each learner.

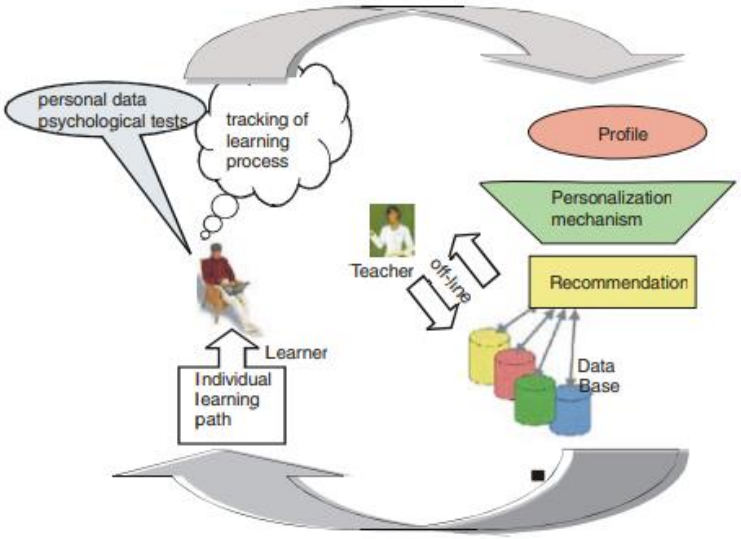


Figure2.1: The idea of learning personalization in e-learning systems [6].

- **Types of personalization:**

-Prescriptive personalization:

Prescriptive personalization is based on triggered by interactions with a user. This includes preferences, recent activity, history, current click behavior, context, time of day, and many more. It is based on a set of logic that runs when a user performs an activity and changes a static view of the content to match their preferences. Prescriptive personalization can be divided into two main types: explicit and implicit personalization. [7].

- Implicit: implicit personalization is the user behavior as a platform is controlled and tracked
  according to the user behavior, and content is presented to them based on a logic that interprets their clicking pattern into the most appropriate content delivery.
- Explicit: Explicit personalization is a visitor's profile determines what content they will see.

- Adaptive personalization:

Adaptive personalization is a new type of customization that predicts the content and experience that the customer is looking for before the interaction and during it [7].

2.2.3 Recommender System

The recommendation system aims to create valuable recommendations for a group of users for items that might interest them. Recommendations for books on Amazon or movies on Netflix are real examples of operating industrial-strength recommendation systems. The design of these recommendation engines depends on the domain and properties of the available data. For example, movie watchers on Netflix often give ratings that are disliked or liked. Recommender systems vary in how they investigate these data sources to find the similarities between users and the elements that can be used to recommend a well-matched pair [8].

2.2.3.1 Recommender System Approaches

The methods of recommender systems can be categorized depending on the information they use to recommend items:

- Collaborative Filter (CF): In CF systems, it uses the user's previous ratings to recommend new items.

- Content-Based Recommendation (CBR): The recommendations in these methods depend on items similar in content to items that the user liked previously.

- Hybrid Curricula: These methods combine collaborative and content-based approaches.

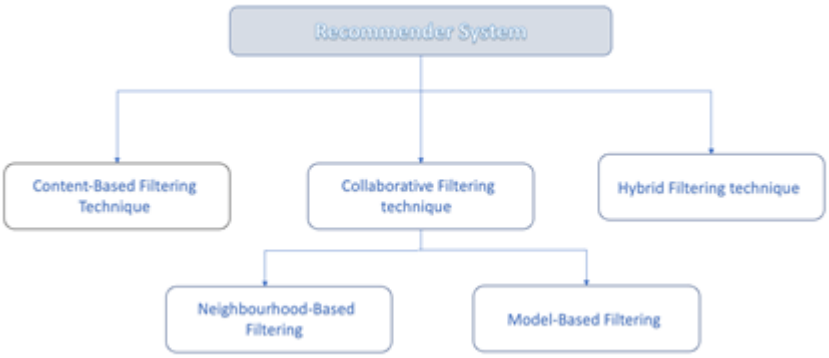


Figure 2.2: Recommender system approaches.

- **Collaborative Filtering**

Collaborative filtering (CF) system collects user feedback in ratings for items in a given domain and exploits the similarities in rating behavior amongst several users in determining how to recommend an item. CF methods can be divided into neighborhood-based and model-

based approaches. In neighborhood-based methods, a subset of users is selected based on their similarity to the active user. A weighted combination of their ratings is used to produce predictions for that user. In contrast, model-based methods assume a basic structure of users' rating behavior and incentivize predictive models based on previous evaluations of all users.

- **Content Based-Recommending**

Content-based filtering (CBF) systems work with the user's preference provided by rating or clicking on a link, which is used in comparison with the content of the items to make recommendations to the user. CBF is standard in information retrieval, where multimedia and text content of documents are used to identify documents related to a user's query. In the context of recommender systems, this refers to content-based proposers, who compare representations recommendations and represent the content describing an item to representations of the content of interest to the user.

2.3 Related work

A brief discovery into the relevant works to our application we will discuss the similarities, differences, and what makes our application excels. We chose the upcoming references based on the most similar content and the technology they used.

2.3.1 Similar Mobile-Application

- **Marrha (pass it on)**

Faten Ibrahim developed Marrha mobile application for both iOS and Android platforms. It is basically for exchanging books, resources, and thrifted products for minor amounts of money. It supports both English and Arabic languages [9] The application allows users to log in as a seller/buyer. It provides a search bar, so you can search a specific title or go to the book's icon from the home page and choose which type of books you want for college or books in general. In college books, the books are divided according to the majors. The available books are divided into categories such as literature, novels, stories, philosophy, etc. You can also search for books according to the city you choose, if you want to spend less delivery money. This application is rated high, and it is the only application of its kind. The application is similar to our work only in exchanging resources. It lacks the target category we are focusing on.

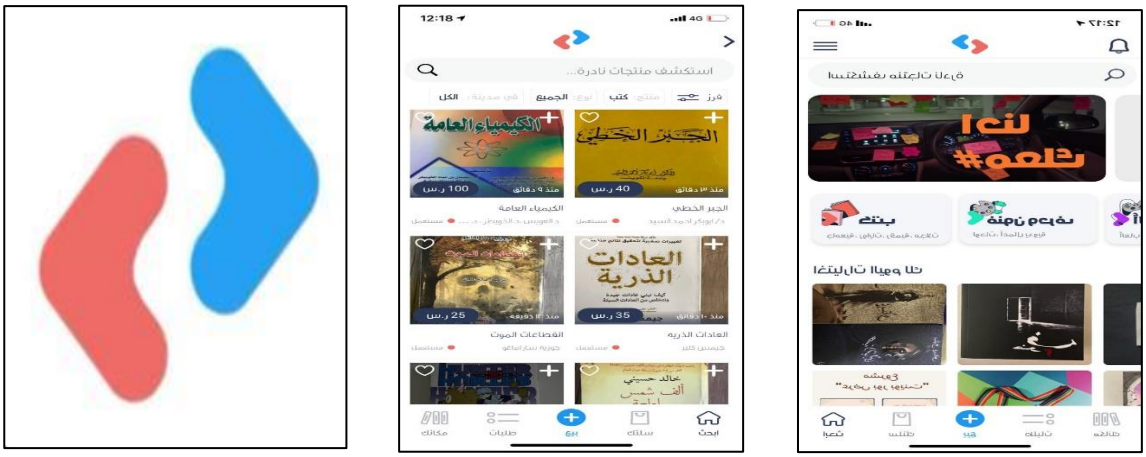


Figure 2.3: Marrha application logo and home page of the app.

- **Shroo7 platform**

The "shroo7 educational" platform was founded in 2016. It is an online educational platform that creates an interactive learning environment by providing educational tools that contribute to learning. It seeks to change the way of teaching the new generation of students and be a pioneer in e-learning. The platform offers its services through a group of academics specialized in various fields [10]. This application allows users to register in any course at any university. It provides a search bar that searches by courses or universities. You can select your college to see all courses in it with the prices for each one. Moreover, you can connect with your professor. The application is similar to our work in providing a way to contact the professors. Also, we all provide another resource for students to learn.

Figure 2.4: Shroo7 platform logo and home page of the platform.

- **Khan Academy**

Khan Academy is a free website, and a mobile application. it is a developer by khan Academy developer for both iOS and Android platforms. It only supports the English language [11]. Khan Academy is an educational app with thousands of educational videos covering math, science, art history, and other subjects. In addition, Khan Academy uses videos, readings, and interactive tools to teach students. Khan Academy has essential features of this education app are downloading the videos to watch them offline and the login function that allows you to access your profile. In addition, the application receives a 5-star EAS Certification and the EAS Recommended status [12].

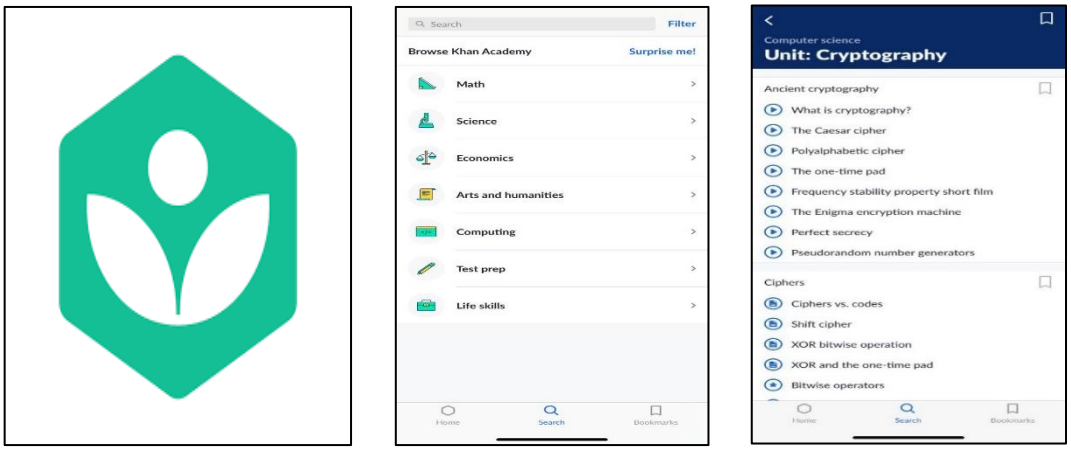


Figure 2.5: Khan academy logo and the home page of the app.

2.3.2 relationship between our work and relevant works

We are going to discuss the features of our work in this section and relevant jobs and highlight what makes our work unique. Our work aims to make the resources reachable for students and save their money and time.

According to the previous similarities, we found in the previous applications and websites, each has a unique feature; however, CS buddy has it all in one place. CS buddy's uniqueness is having all the resources for free while the previous websites have limited resources for free. One of the previous applications was for exchanging books. However, their books are not specialized for educational scope and in computer science specifically, and that is why the books are mostly not available. Pervious websites and applications lack, in general, a targeted audience. Our application first targeted the audience and then collected all they might need from resources to exchange books. Our application's strength is in using personalization for each user according to their personal preferences.

Table 2.1: The differences between our application and other applications.

Features	Marrha App	Shroo7 platform	Khan academy app	Our app
Browsing content without logging in	✓	✓	✓	✓
Providing a brief description of each course			✓	✓
Providing a space to advertise for study groups/volunteering tutoring				✓
Providing a book exchange service	✓			✓
Availability of references and resources				✓
Searching for ambiguous terms				✓
Providing explanations of courses		✓	✓	✓
Providing a private conversation between students to share services				✓
Providing instructors' emails				✓
Free			✓	✓

2.4 Summery

In this chapter, we overviewed some aspects of personalization. Initially, we began with the impact of the coronavirus pandemic on education and how it affected the education of students. Also, we reviewed Personalization, And recommender system. We clarified the difference between personalization and recommender systems. Also, we discussed some of the applications related to our work. Finally, we discussed the features of our work in this section and relevant jobs and highlighted what variety our project differently.

Chapter 3: System analysis

This chapter's main goal is to analyze the application and generate its models. This chapter is divided into four sections: analysis of the survey, requirements elicitation, requirements specification, and developmental (or research) methodology.

3.1 Survey Analysis

Our application mainly targets the computer science students of Taibah University. So, we made a survey aimed to collect data about the academic life of the students. Based on the targeted group among Taibah University in October 2021, we received answers that confirmed the problems we mentioned before. The number of participants has reached 78 students. (94%) female, and (6%) male.

We asked the participants if they faced difficulty in communication with other students. We got (59%) with "No" as an answer, while (41%) answered "Yes". The number of participants that answered yes shows around half of the students have communication difficulties. Also, we also asked them whether they found it hard to ask other students for help. Most of them (70%) reported that they find it hard to seek help from others. However, approximately (32%) of respondents answered they do not see it hard, as shown in Figure 3.1. The difficulty of interaction between students is a problem that we consider solving in our work.

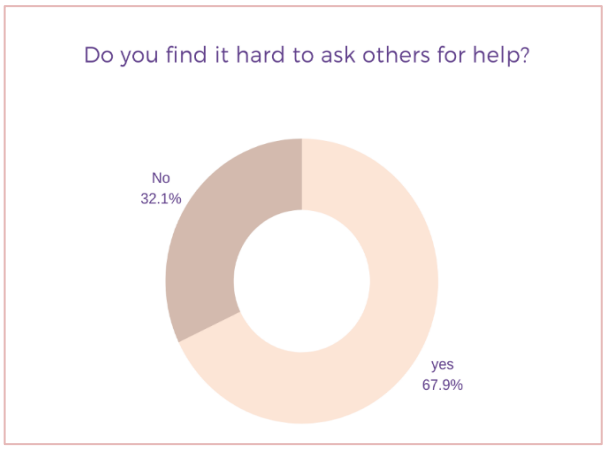


Figure 3.1: Interaction between students.

As shown in Figure 3.2, a vast number of participants (86%) agreed that finding reliable resources take a lot of time. Consequently, one of the essential keys is to provide reliable resources in one place that saves the student effort and time. Also, we found around half of the students (45%) did not have current instructors' emails. Therefore, to make it easier for students to find their instructors' emails, we add it as a feature.

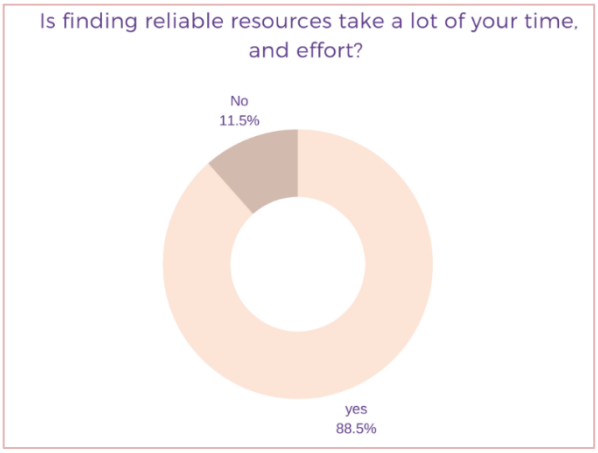


Figure 3.2: Reliable resources take a lot of time and effort.

When we asked the participants whether they had ever borrowed a book from a student, (24%) of them answered "yes". Also, the students were asked about the best way to deal with the books after they finished studying them. (41%) of students prefer to donate them for free, while (29%) prefer to offer them to borrow. (18%) of the responders chose to provide the books for sale at a lower price, As shown in Figure 3.3. Therefore, the students need a platform that helps them deal with books in ways they prefer (donate, borrow, sell).

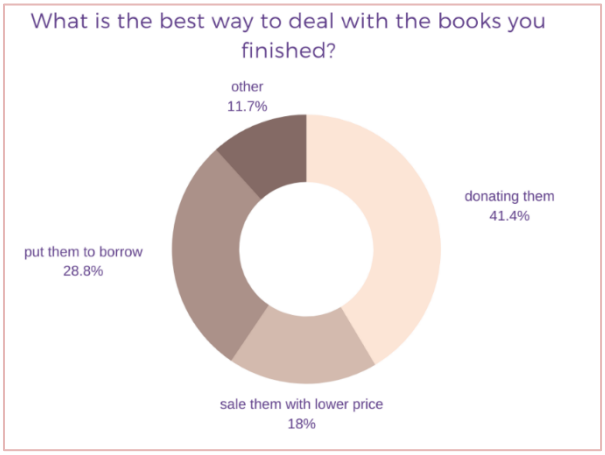


Figure 3.3: Participant's ways to deal with books.

We asked participants about their opinion of what prevent the students from buying books or references, (44%) said they could not afford it, maybe because it is expensive, (37%) needed part of the book, (16%) said not all books are available, so the students have faced a problem in finding the books. We wanted to know if students agreed with the idea of a study group or not, so we asked the students if they were interested in participating in study groups. (73%) of participants said "Yes " and (27%) said "No" as shown in Figure 3.4. Therefore, we concluded from this survey that there is a need for a platform that provides a space that enables students to volunteer tutoring.

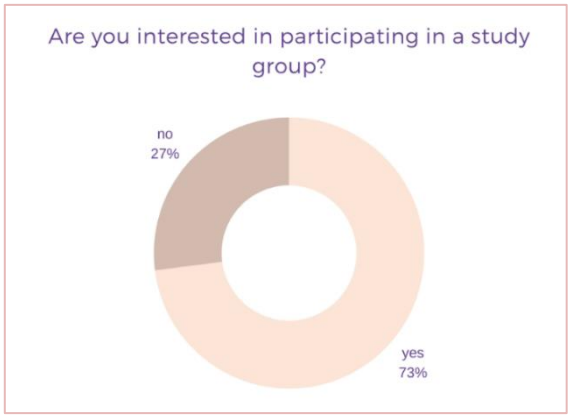


Figure 3.4: Students opinion about study group.

3.2 Requirement elicitation

Requirement's elicitation aims to understand stakeholders' work and the functions related to them. This section will identify our system's functional and non-functional requirements based on what we have done in chapters 1 and 2. Also, the result we got from the survey analysis.

3.2.1 Functional Requirements

The functional requirements define the system's functions and describe the system behavior or what the system should do. For our system, we divided the functional requirement into two parts: The admin and the student, and we discussed the functions of each type as follows:

- **Admin**

  1- The system offers either to register as an admin.

  2- The admins can set their account (name, email, password).

3- The system allows the admin to add and delete courses.

4- The system allows the admin to write and edit the description of the courses.

5- The system allows the admin to upload and edit the resources of the courses.

6- The system allows the admin to add and edit the instructors 'emails.

- **Student**

1- The system allows the student to register.

2- The students can set their account (name, email, password).

3- The system enables the students to edit their profiles.

4- The system allows the student to view courses and their content.

5- The student can view and add their courses.

6- The student can search for terms.

7- The system allows the student to post advertisements.

8- The system enables the student to text the advertiser.

3.2.2 Non-Functional requirement

Non-Functional Requirements describe the system's operational capabilities and constraints that increase its functionality. Also, it should consist of the other requirement does not discover in Functional requirement. The nonfunctional requirements are listed in Table 3.1:

Table 3.1: Non-functional requirement

Security	The access authentication is protected using passwords and email.
Availability	The system should available when it is needed to be accessible 24/7.
Efficiency	The system should have fast response time.

Accuracy	The system should provide correct instructor's emails and reliable resources.
Usability	The system should be easy to use by providing easy UI to students and admin.
Performance	The system should save the time of students by recommending anything relating to the student's courses.

3.2.3 User Requirements or Domain Requirements

1- Smart hand-held device.

2- Internet connection.

3- Install CS buddy application.

3.3 Requirements Specification

UML (Unified Modeling Language) diagram is used to show the interaction in system between actors (admin, student) and use cases as shown in Figures 3.5- 3.7.

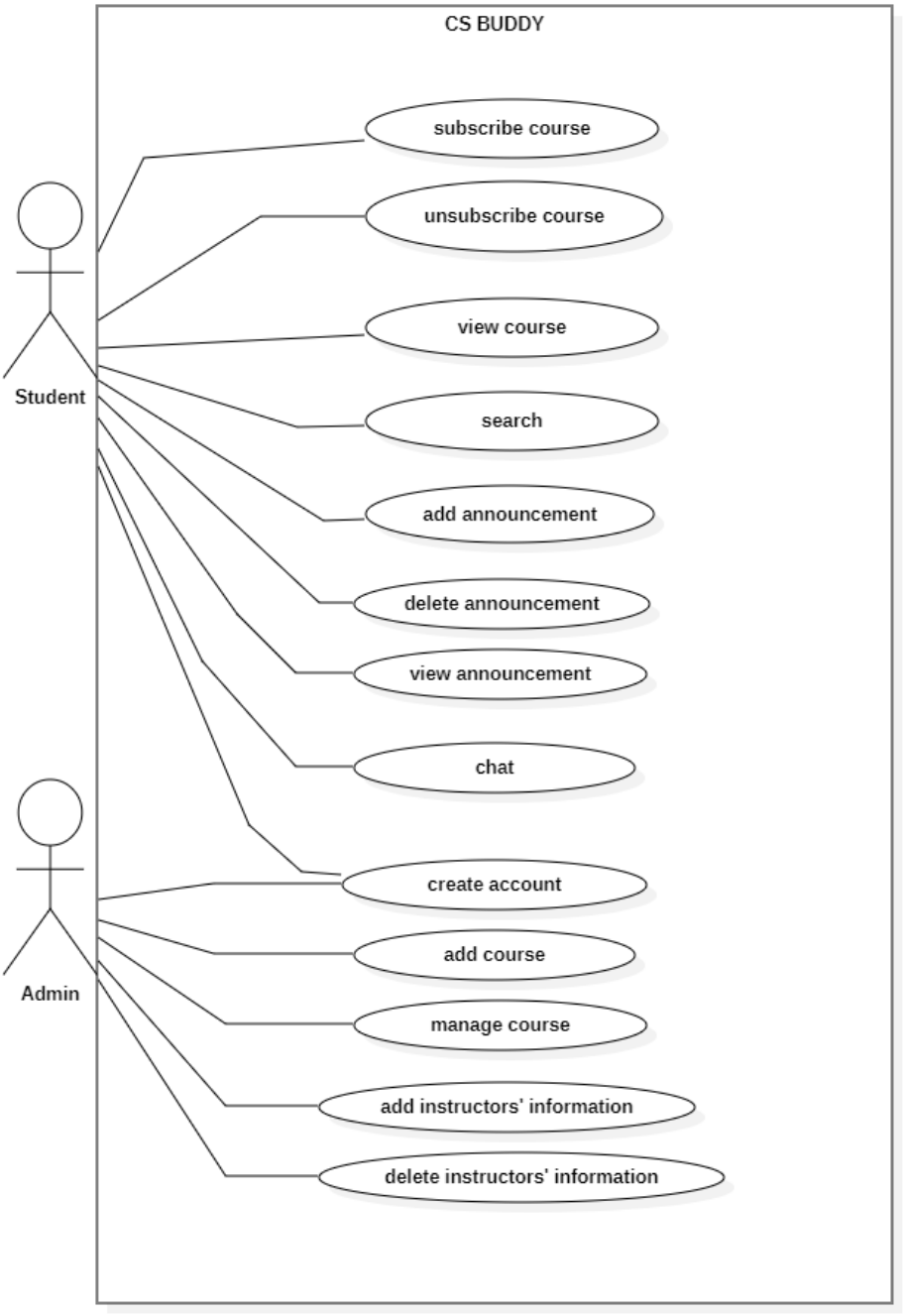


Figure 3.5: Use case diagram.

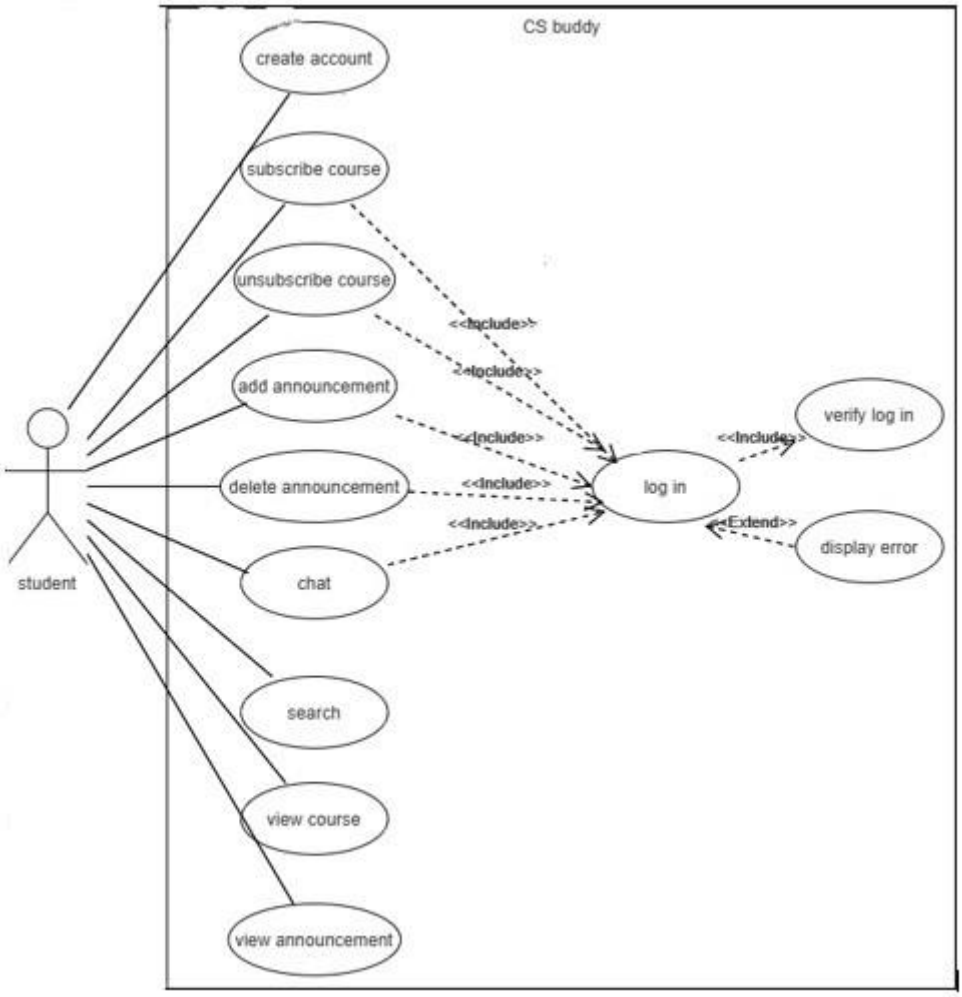


Figure 3.6: Student use case.

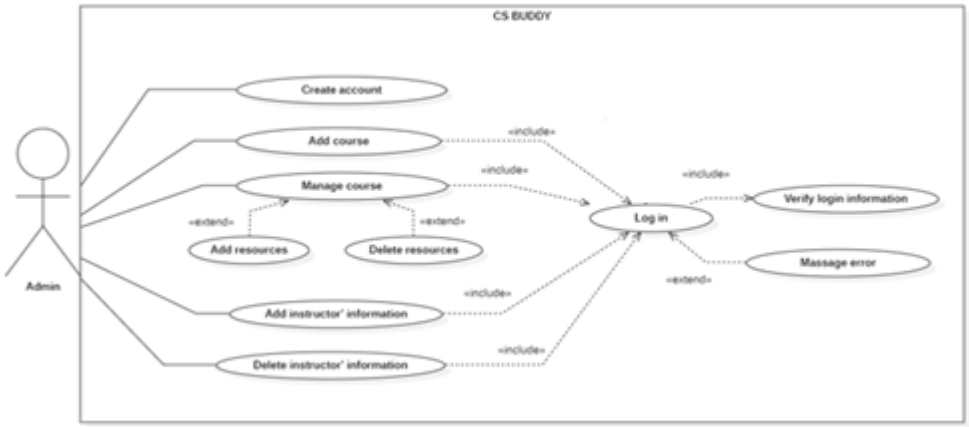


Figure 3.7: Admin use case.

Table 3.2: Subscribe course use case.

Use Case Name	Subscribe Course
Use Case ID	1
Actors	Student
Description	Allows student to subscribe course.
Pre-condition	The student be logged in.
Post-condition	The course appears in the home page.
Normal flow	1- The student clicks course icon. - The system opens a list of courses. 2- The system allows student to subscribe course by clicking on "subscribe" button at the right of the course name. - The system adds the course to course section at home page. 3- The student can find the course in the course section on the home page.

Table 3.3: Unsubscribe use case.

Use Case Name	Unsubscribe Course
Use Case ID	2
Actors	Student
Description	Allows student to unsubscribe course.
Pre-condition	The student must be logged in and subscribed to the course.
Post-condition	The course removed from the home page.
Normal flow	1. The student clicks the "course" icon. - The system opens a list of courses. 2- The system allows the student to unsubscribe course by clicking "unsubscribe" button at the right of the course name. - The system removes the course from course section on the home page.

Table 3.4: View course use case.

Use Case Name	View Courses
Use Case ID	3
Actors	Student
Description	Allows student to view all courses.
Pre-condition	-
Post-condition	The list of courses is presented
Normal flow	1- The student can view the list of courses by clicking on the three lines icon. - The system receives the action and opens page of courses page.

Table 3.5: Search use case.

Use Case Name	Search
Use Case ID	4
Actors	Student
Description	Allows student to search about any CS terminology and find which courses are mentioned in.
Pre-condition	-
Post-condition	A list of courses that have dealt with the terminology is presented or blank if there is no match result.
Normal flow	1- The student can search for a terminology by clicking the search icon. - The system receives the action and allows the student to write the terminology in the search box. 2- The student enters the terminology and clicks "search". - The system displays a list of courses as result. 3- Student can see the list of courses that discuss the terminology.

Table 3.6: Add announcement use case.

Use Case Name	Add announcement
Use Case ID	5
Actors	Student
Description	Allows the student to advertise a book or announce a study group.
Pre-condition	The students must be logged in.
Post-condition	The students get notified about adding an announcement and the database updated.
Normal flow	1- The student can add an announcement by clicking on the "add announcement" button in the home page. - The system receives the action and shows two fields, one for the announcement subject and the other for writing a brief description of what the student wants to announce. 2- The student writes the announcement and clicks "post" - The system publishes the announcement and appears on the home page and updates the database.

Table 3.7: Delete announcement use case.

Use Case Name	Delete announcement
Use Case ID	6
Actors	Student
Description	Allows the student to delete an announcement.
Pre-condition	The students must be logged in.
Post-condition	The announcement is deleted, and the database is updated.
Normal flow	1- The student can delete an announcement by clicking "delete" button at right of the announcement subject from the home page. - The system receives the action and deletes the announcement and updates the database.

Table 3.8: View announcement use case.

Use Case Name	View announcement
Use Case ID	7
Actors	Student
Description	The student can view an announcement for books or a study group.
Pre-condition	The student must be logged in.
Post-condition	-
Normal flow	1- The student can view published announcements by clicking on "For more" at the announcement section on the home page. - The system shows a list of all published announcement.

Table 3.9: Chat use case.

Use Case Name	Chat
Use Case ID	8
Actors	Student
Description	Allows communication between the students
Pre-condition	The students must be logged in
Post-condition	the student has chat with other students
Normal flow	1- The student can have a chat with the advertiser by clicking on the announcement. - the system opens chat between student and advertiser, and the chat is saved on the chat page.

Table 3.10: Create account use case.

Use Case Name	Create account
Use Case ID	9
Actors	Student/Admin
Description	Allow users to create an account.
Pre-condition	-
Post-condition	Student/Admin become registered user.
Normal flow	1- User can create account by clicking “Sign up" option on welcome page. - The system receives the request and shows form with the following fields: 1.1 Name 1.2 Email 1.3 Password 2- The user enters the required information. - The system validates the entered values. If the user's values are validated, the information will be stored in the database, the user will take back to the - The system validates the entered values. If the user's values are invalidated, the system will send try again message.

Table 3.11: Add course use case.

Use Case Name	Add course
Use Case ID	10
Actors	Admin
Description	The admin can add a new course and upload its contents.
Pre-condition	The admin be logged in.
Post-condition	A course is added, and database updated.
Normal flow	1- The admin can add the course by clicking on the "Courses" icon from the home page. - The system receives the action and opens the courses list page. 2- The admin clicks on the plus icon. - The system opens a page with the following fields appears • The course's name • The course's description • Upload resources 3- The admin enters the required field and clicks the arrow icon. - The system adds the course and updates the database.

Table 3.12: Manage course use case.

Use Case Name	Manage course
Use Case ID	11
Actors	Admin
Description	Allows admin to manage courses' resource.
Pre-condition	The admin be logged in.
Post-condition	Course resource is updated, and database updated.
Normal flow	1- The admin can manage the course resource by clicking on the "courses" icon from the home page. -The system receives the action and show a list of courses. 2- The admin clicking on “Manage” button at the right of the course name. -The system receives the action and show the manage course page.

	3- The admin clicks on “delete” button in the right of the resource at resources section. -The system allows the admin to delete the course’s resource and updates the database. 4- The admin clicks on “Add resource” button in below at resources section. -The system allows the admin to add a course’s resource, and updates the database

Table 3.13: Add instructors’ information use case.

Use Case Name	Add instructor’s information.
Use Case ID	12
Actors	Admin
Description	The admin can add a new instructor’s information.
Pre-condition	The admin must be logged in.
Post-condition	An email is added, and database updated.
Normal flow	1-The admin can add the instructor’s information by clicking on the "instructor’s information" icon from the home page. - The system opens the instructor’s information list page. 2-The admin clicks on add email button. - The system opens page with the following fields appears. • The instructor’s name. • The instructor’s email. 3-The admin adds instructor’s information. - the system adds the information and updates the database.

Table 3.14: Delete instructors' information use case.

Use Case Name	Delete instructor's information
Use Case ID	13
Actors	Admin
Description	The admin can delete the instructor's information.
Pre-condition	The admin must be logged in.
Post-condition	The instructor's information is deleted, and the database updated.
Normal flow	1- The admin can delete the instructor's information by clicking on the "instructor's information" icon from the home page. - The system opens the instructor's information list. 2- The admin clicks on the delete button on the right of the instructor's name. - The system deletes the instructor's information and updates the database.

3.4 Developmental (or Research) Methodology

This section explains our solving methodology in detail by describing the development process model and showing the working procedure used, the data collection process, the business and technical constraints, and the tools and software needed.

The current development approach is the agile approach. The agile development methodology provides the ability to measure the direction of a project throughout the development cycle**.** It is the term used to describe software development approaches that use continuous planning, learning, improvement, team collaboration, evolutionary development, and early delivery. In addition, it encourages flexible responses to change. Our project is divided into chapters, with each one focusing on a critical development phase. The requirements are approximately fixed and constant, and the phases are consistent and clear because the main idea is unambiguous, and the same team is working on entire phases, see Figure 3.8.

Figure 3.8: The agile development phases.

The used tools and technologies in this project are shown in Table 3.15

Table 3.15: Tools and technologies.

Technology	Logo	Use
Microsoft Word		Documentation
Microsoft Forms		Google Forms
Grammarly		Grammar and spelling check
App store and play store	Available on the App Store	Apps search
Google Scholar	Google Scholar	Scientific search engine

Draw		Star UML diagrams
Adobe Xd		Prototype and UI design
Draw.io		Draw diagrams

2.4 Summery

In this chapter, we mainly defined the functional and non-functional requirements. First, we initiated a survey then analyzed the survey. After that, we designed the UML use case diagrams for the system and the users. Then, we chose the agile approach in the development methodology and explained its use in our project. Finally, we presented the limitations and constraints of our project and gave the used tools and technologies.

Chapter 4: System Design

In this chapter, we discuss the system's structural design by presenting the architectural design concerned with organizing the components and their communications. Then, by using the object-oriented design, we describe the structure of the system. Finally, we design the data model and the interface.and user interface design is presented.

4.1 Architectural Design

The architectural diagram is a diagram of a system used to abstract the overall outline of the system and the relationships, constraints, and boundaries between components. Figure 4.1 shows the architectural design of our system.

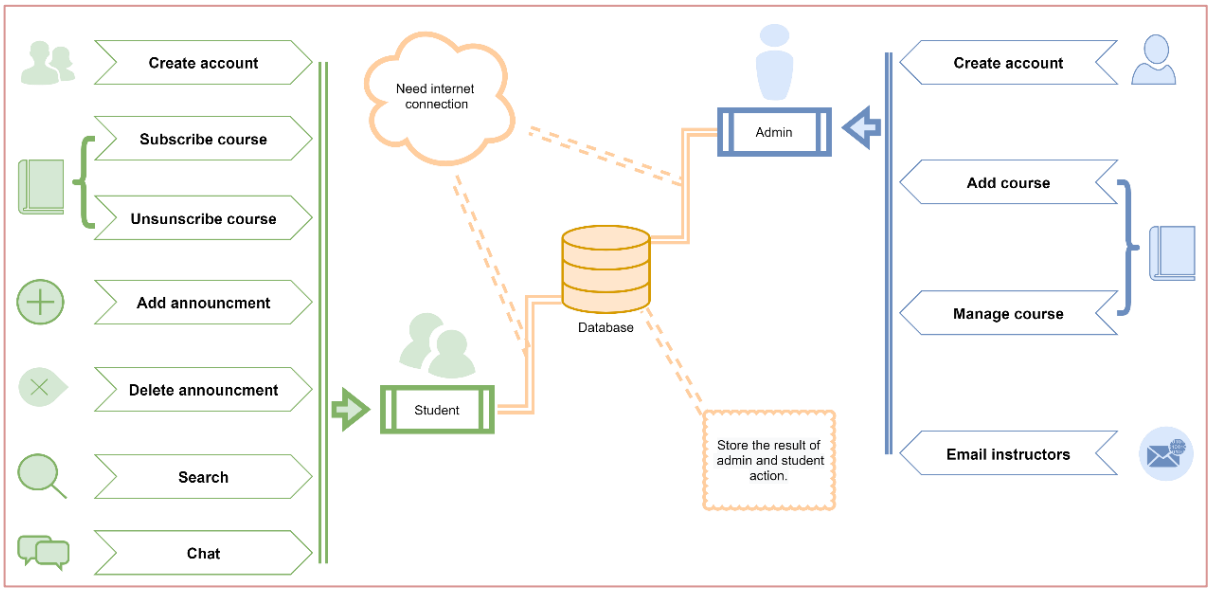


Figure 4.1: Architectural design.

4.2 Object Oriented Design

The object-oriented system includes defining the context of a system and designing the system's architecture.

4.2.1 Structural Static Models

- **The Class Diagram**

The class diagram is used to represent the static diagram by mapping the structure of the systems using classes, attributes, relations, and operations between objects. The class diagram

is one of the principal UML diagrams. It describes the system's structure by showing the basic classes and clarifying their attributes and methods.

In Figure 4.2, there is an inheritance relationship between the admin class and the student class, inherited from the person class. The class diagram describes the types of relationships, whether one-to-one, one-to-many or many-to-many. Also, the line of the relationship, its kind, is shown, whether it manage or subscribe or view or post. Finally, the help program helps build the required system.

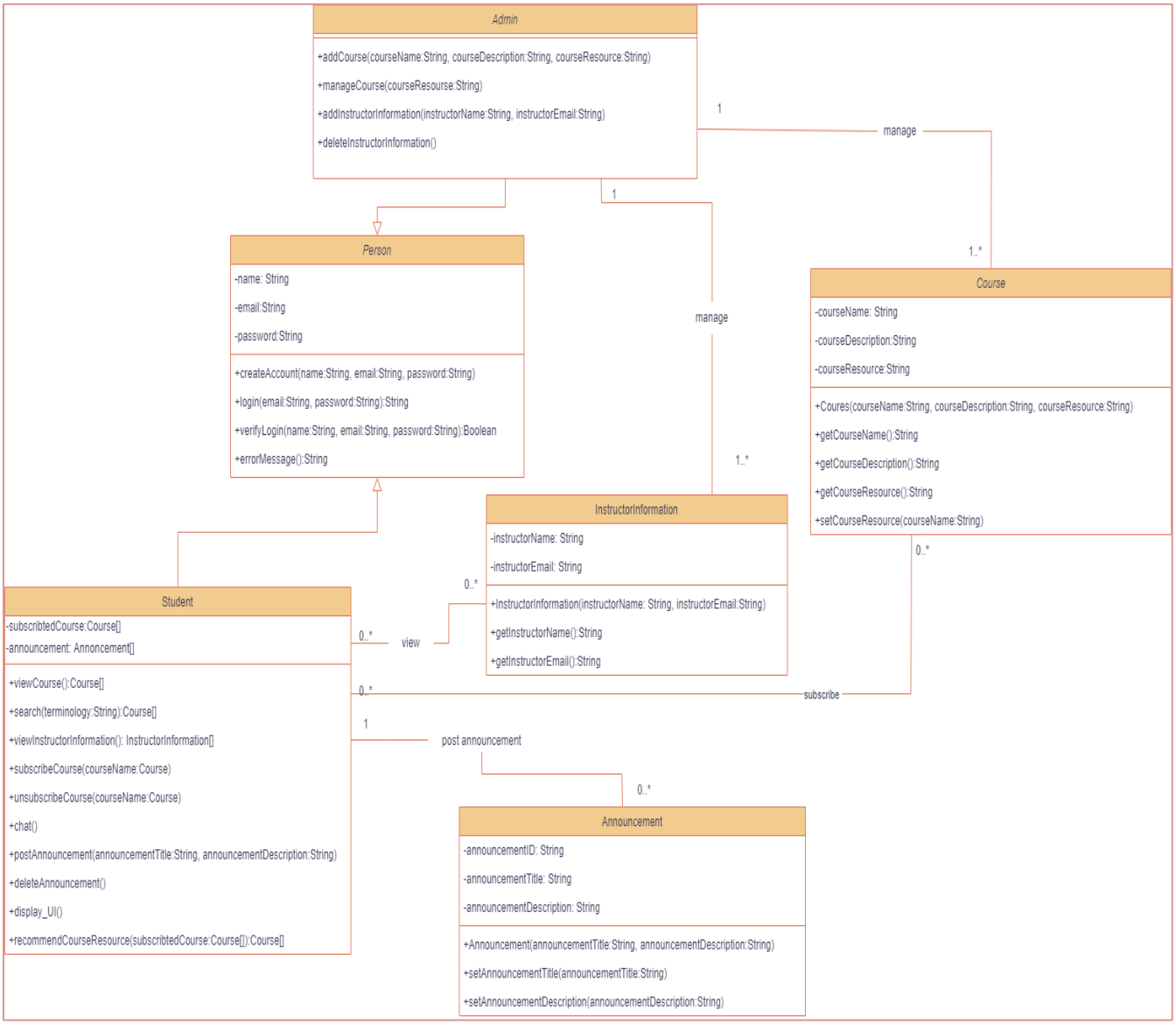


Figure 4.2: Class diagram.

4.2.2 Dynamic Models

Dynamic models are mainly used to describe the program's behavior with the events from a user.

- **The Activity Diagram**

The activity diagram represents the flow of control between activities of the program. The activity diagram uses a circle as a start. In Figure 4.3, the flow from the beginning goes into two branches, one for search activity and the other for creating an account. The diamond for a decision is if the login was successful, the admin or user could use the functions if it was unsuccessful. They would go back to the login page, and the flow goes till the double circle below means the end.

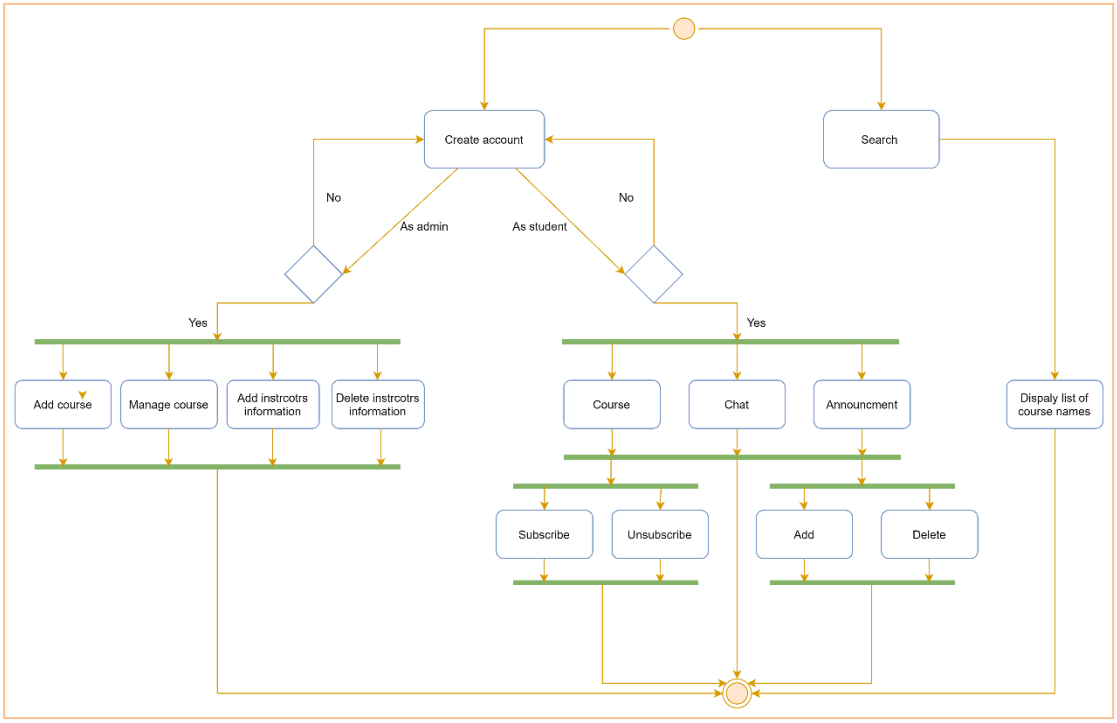


Figure 4.3: Activity diagram.

- **The Sequence Diagram**

Sequence diagrams are used to show object interactions arranged in time sequence in the field of software engineering. They are a popular dynamic modeling solution in UML. They focus on lifelines or the processes and objects that live simultaneously and the messages exchanged to perform a function of the actors before the lifeline ends. Figure 4.4 shows the

sequence diagram for the student actor and all the related objects and how they interaction with each other in the system.

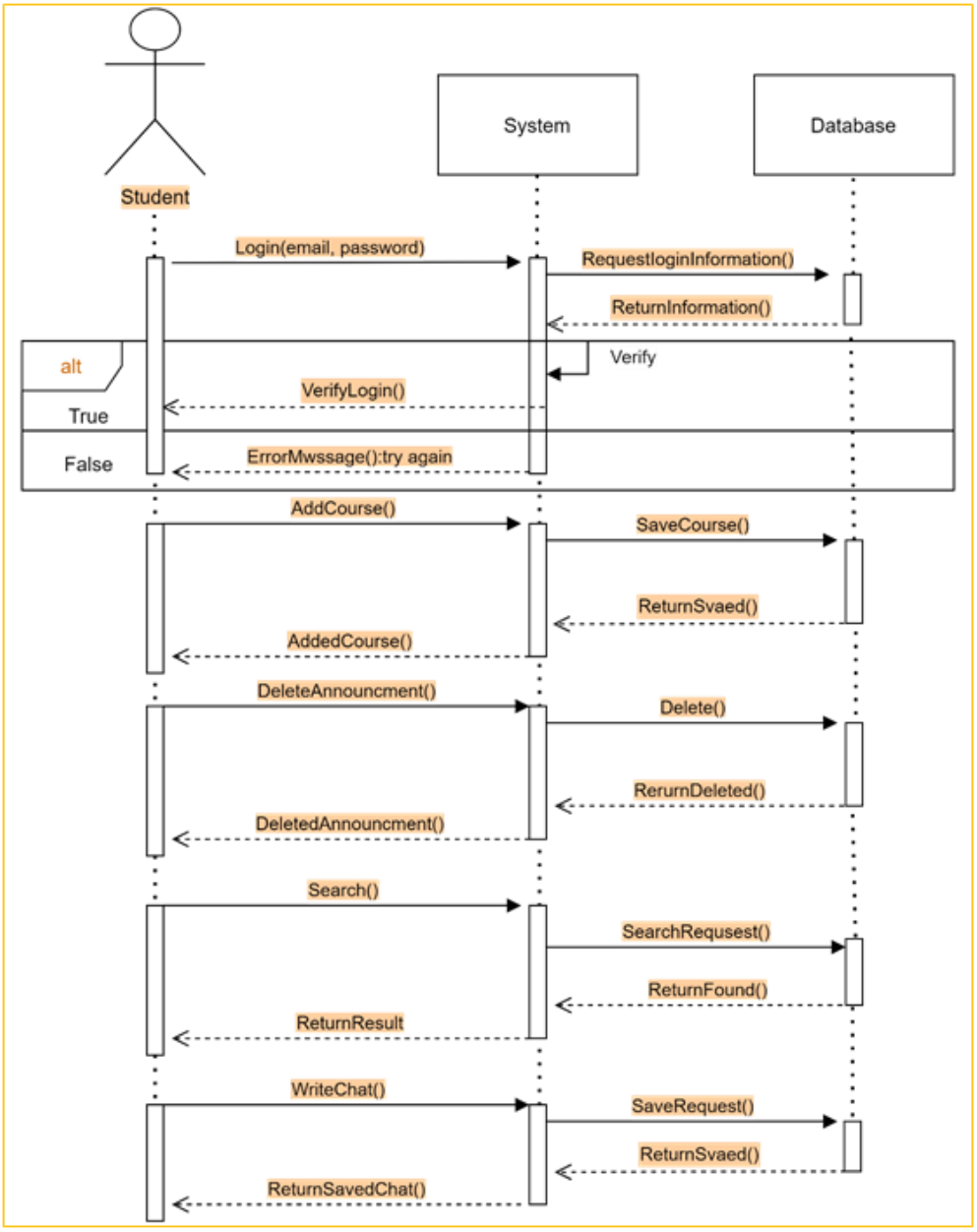


Figure 4.4: Sequence diagram.

4.3 Data Modeling

- **The Database Entity Relationship Diagram**

One of the diagrams is called the Entity-relationship diagram. Also known as ER is a diagram that defines the relationship of entity sets stored in a database. ER diagrams help to

clarify the logical structure of databases. It is designed based on three basic concepts: entities, attributes, and relationships. In Figure 4.5, presents the ER diagram of our system.

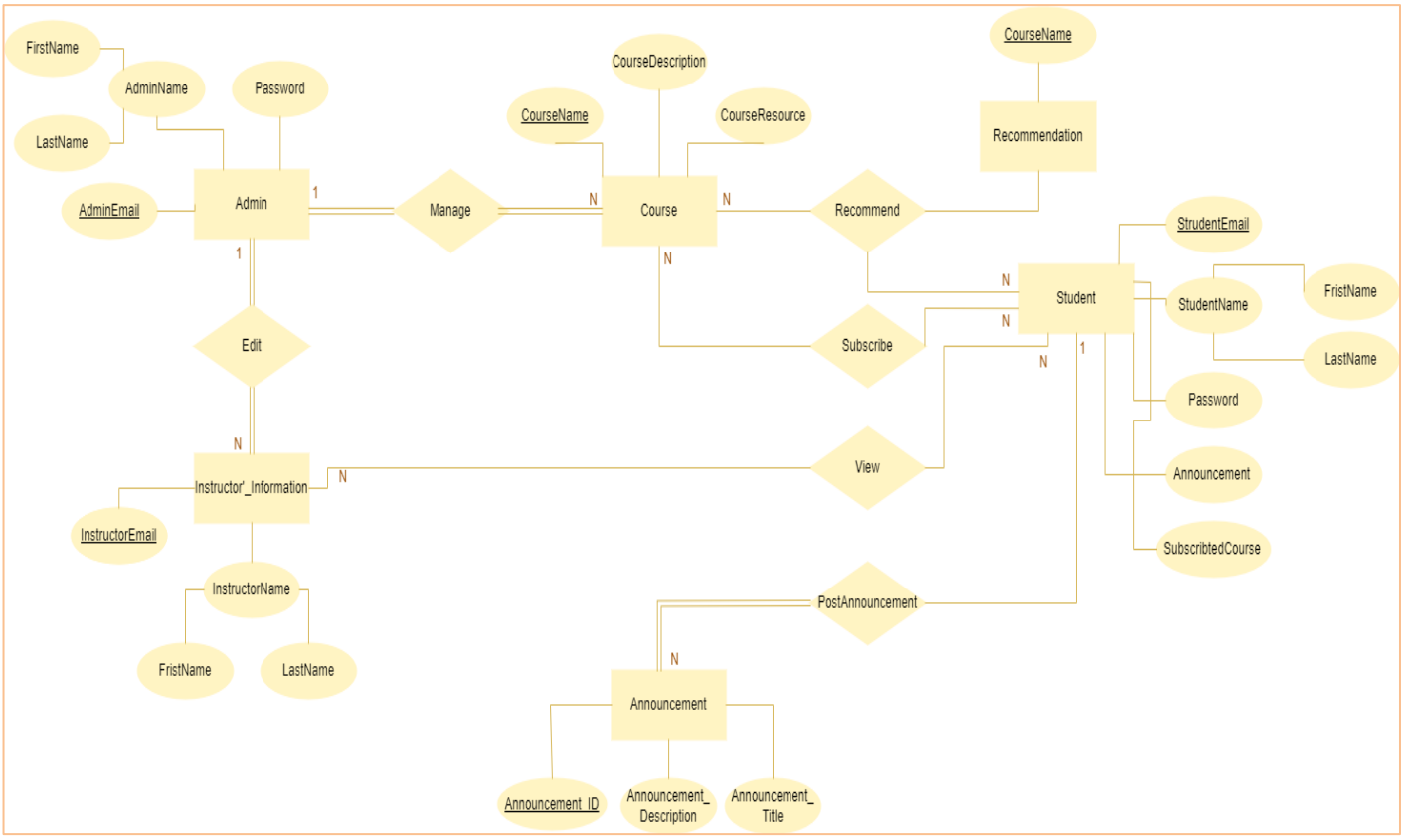
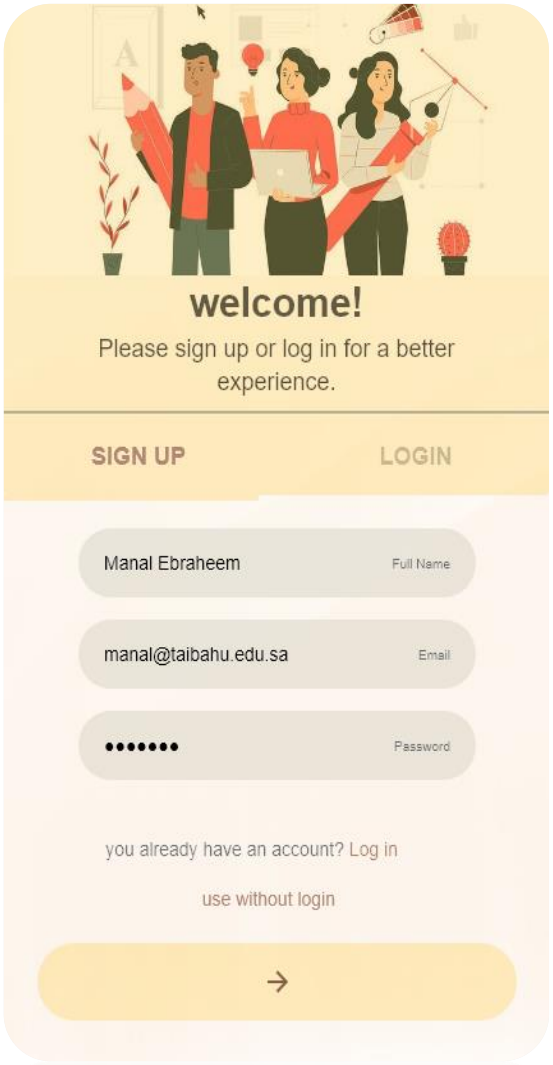


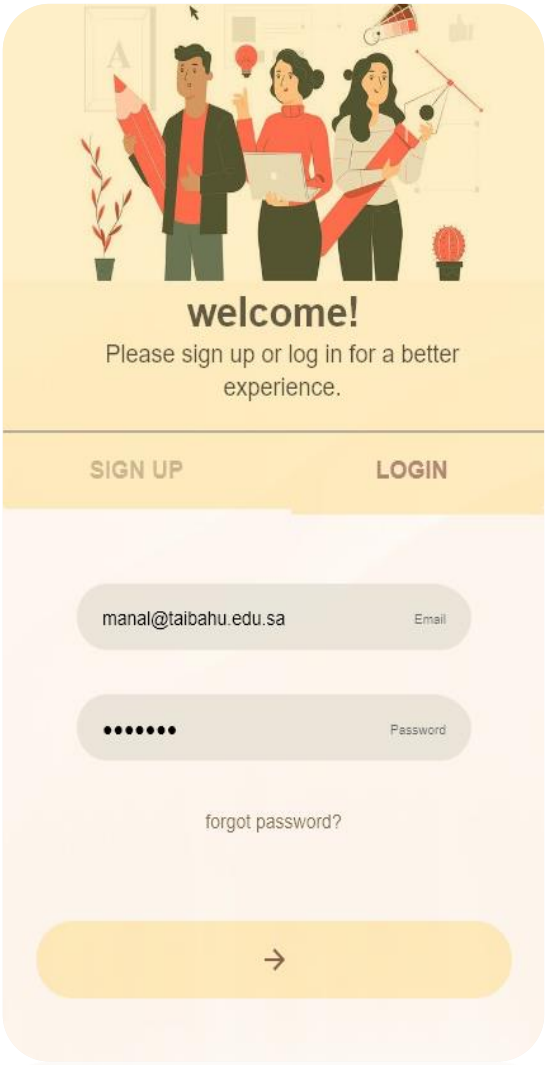
Figure 4.5: The entity relationship diagram.

4.4 User Interface Design

User interface (UI) is the design of user interfaces for software. It focuses on increasing the usability and the user experience (UX). Also, to make the user's interaction simple and more efficient.

- **Sign up and login**

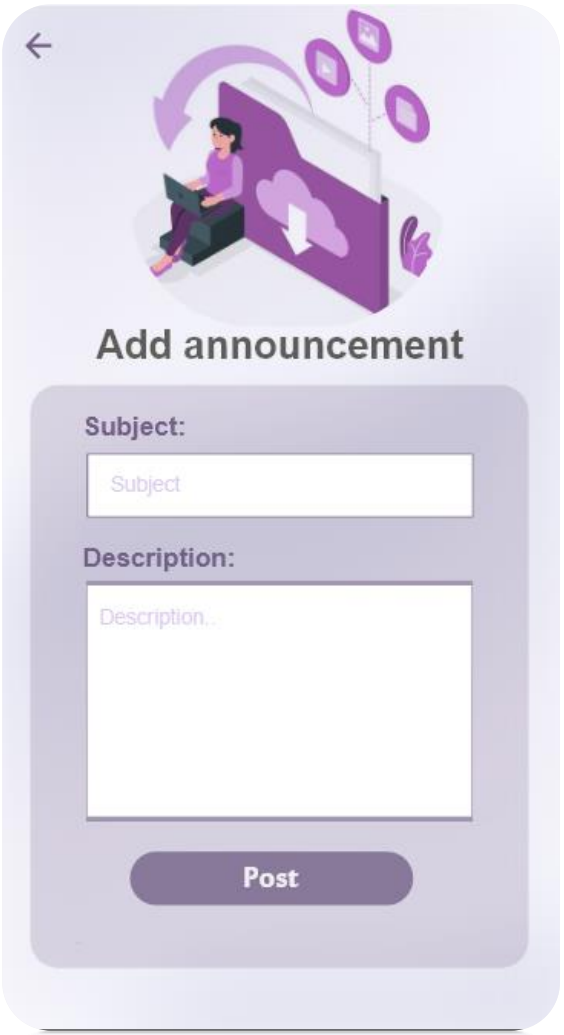




❖ **For student**

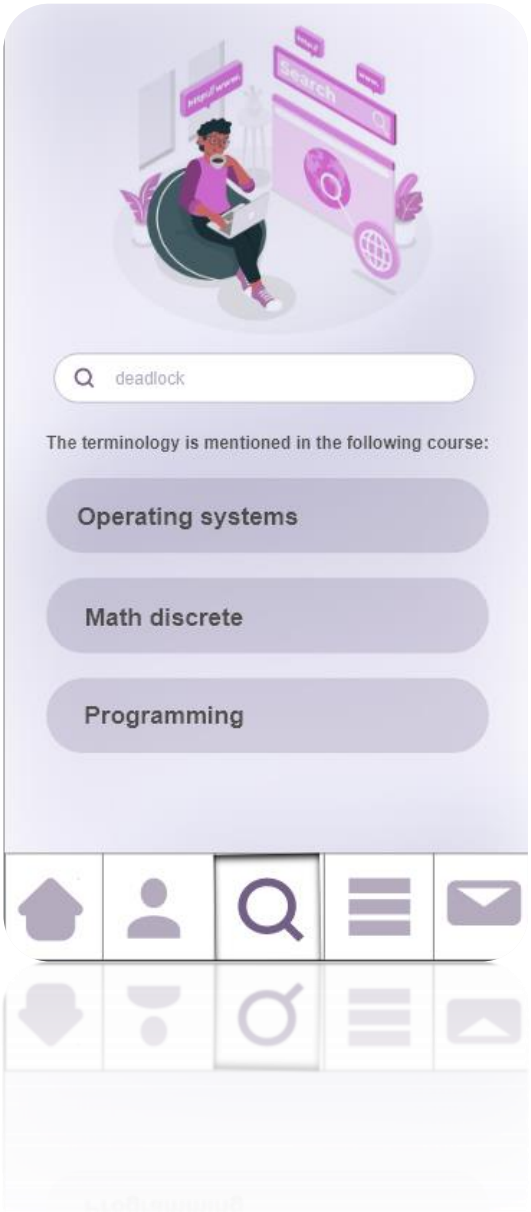
●Home page

● Add announcement

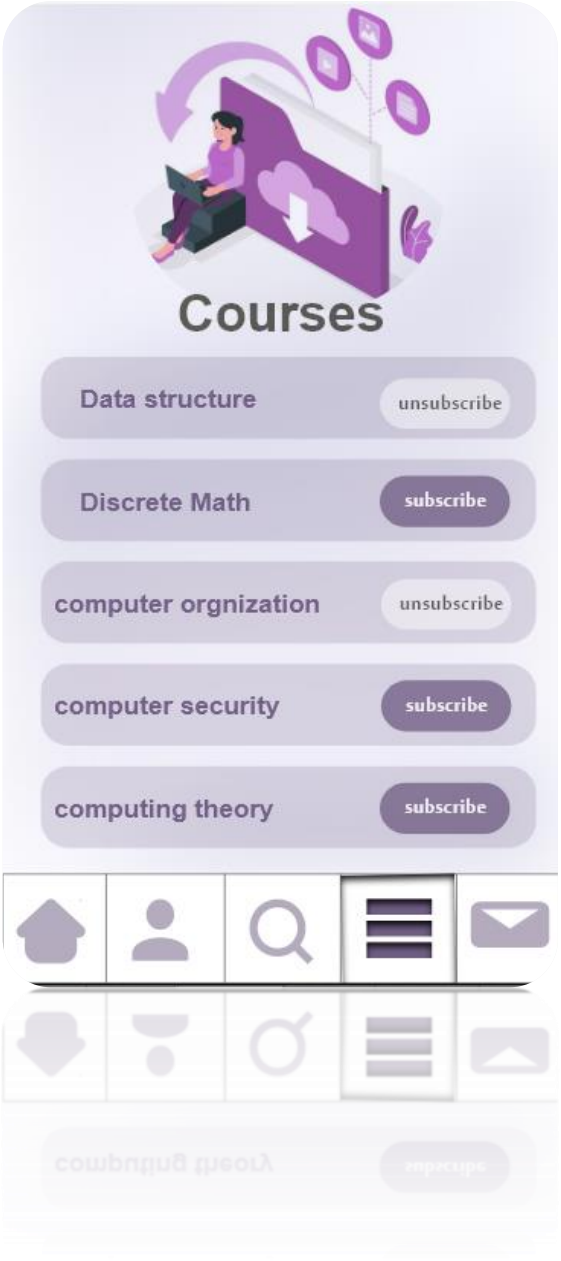


- Instructors’ information

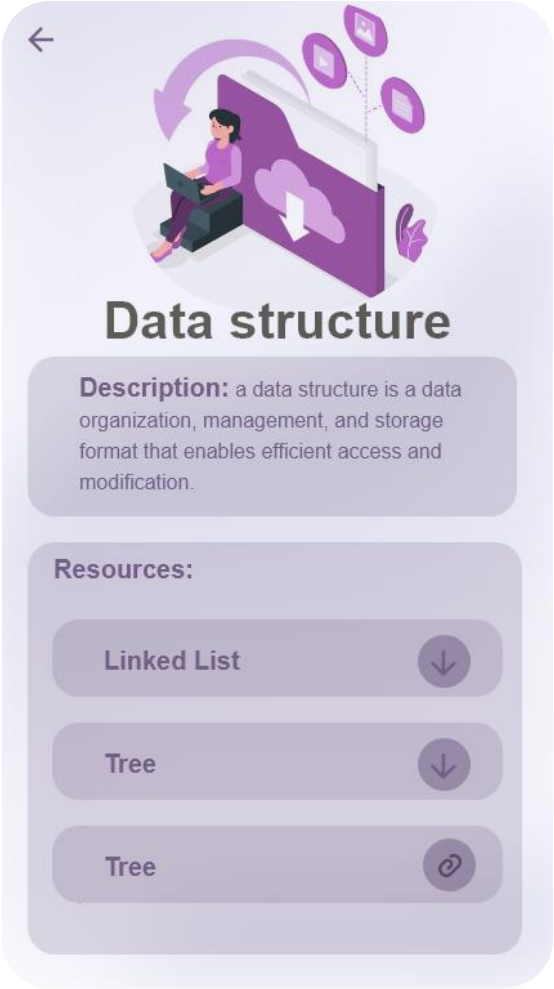
- Search



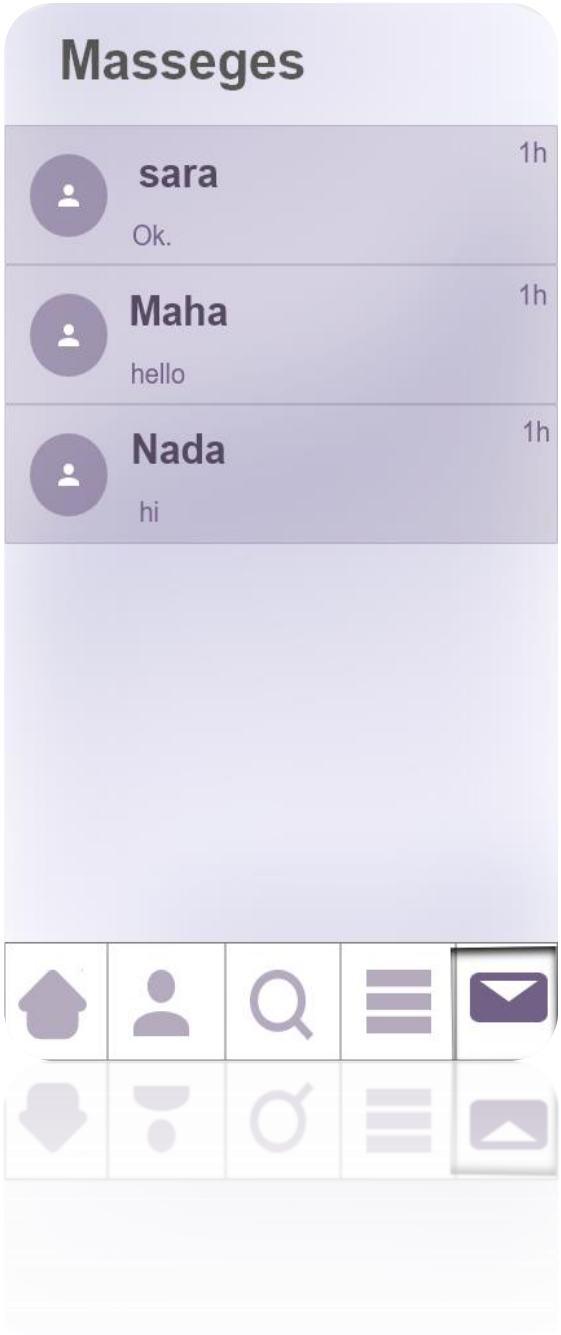
- Courses page

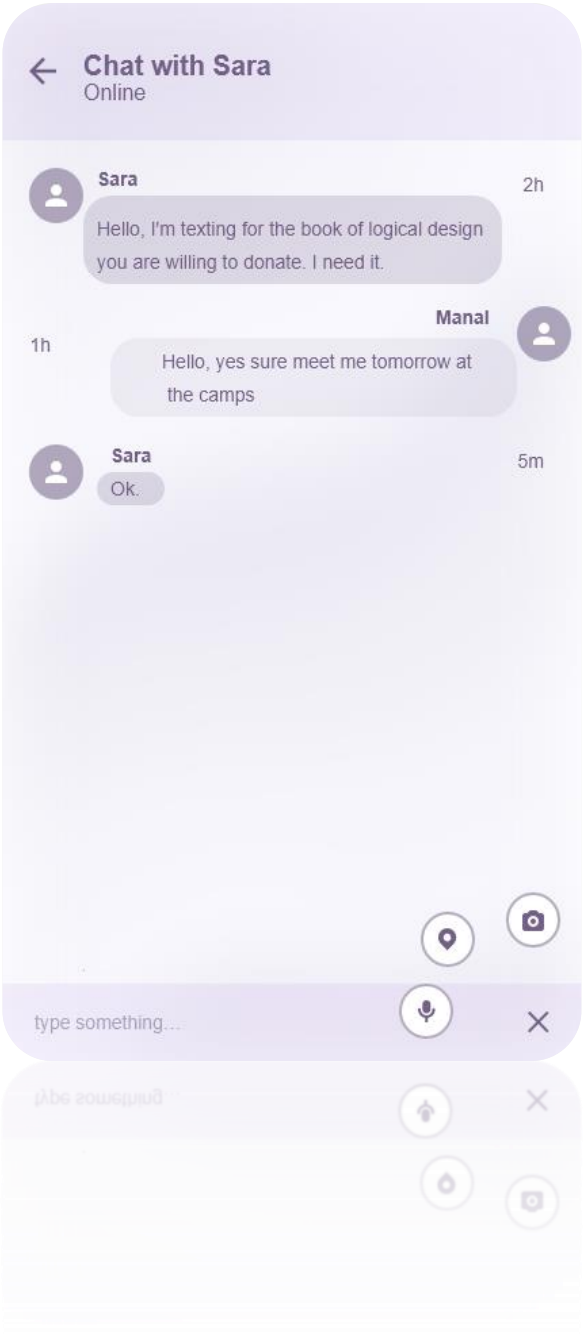


- Course page



- Chat


Masseges
sara
1h
Ok.
Maha
1h
hello
Nada
1h
hi


Chat with Sara
Online
Sara
2h
Hello, I'm texting for the book of logical design you are willing to donate. I need it.
Manal
1h
Hello, yes sure meet me tomorrow at the camps
Sara
5m
Ok.
type something...

❖ **For admin**

- Home page

- Manage instructors' information
- Courses

- Add course

- Manage course

Chapter 5: Conclusion and Future Work

5.1 Conclusion

The "CS buddy" aims to help the students finding the reliable resources and save their time and efforts. Also, CS buddy aims to provide a platform for students with recommendation features to attract them. Finding the resource is usually tedious and time/effort consuming for students. The recommender system approach suggests resources' recommendations customized for each course, which reduces the complexity of the process and increases efficiency. In addition, the application provides a space to allow the student to announce to other students about either study groups or offering books. Our target is to minimize students' troubles using CS buddy application. The main work objectives are thoroughly understanding the problems and the needs, intensively studying the system and algorithms to be used, and effectively finishing the developmental phases.

5.2 Goals Achieved

In this semester, we finished building the basic preparations and most fundamental phases for our application, which were mentioned before as objectives. The goals achieved were spread among the chapters as follows:

- Problem definition and needs determination.
- Extensive search about the recommender system approach as a background.
- Related work and similar applications analyzing.
- Survey publishing and analysis.
- Requirement's elicitation and specification.
- Developmental methodology detailing.
- Architecture, object-oriented, and user interface design.
- Data modeling.

5.3 Limitations and Future Work

During our work and research for this work, we stand up to some limitations and potential improvements that would add more value and increase efficiency. In order to improve the CS Buddy functionality, especially the interactions between the students, we want to provide online study groups and make the students contact from a distance. Also, the scope of CS Buddy can include expansion by being in the service of the information system department. Another limitation that can occur in the system search engine is the result of the searching is limited on the name of the course; it can be more effective if we extend the search result to provide an explanation of the term besides the name of the course that deals with the term.

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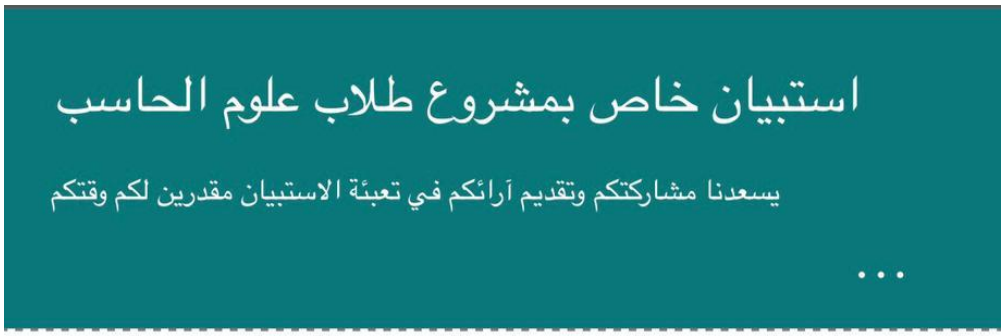
Appendix A: Survey

Below are the survey questions that we wrote and collected answers from then analyzed.



* Required

1. الجنس *

- انثى
- ذكر

2. هل انت طالب في كلية علوم وهندسة الحاسب الآلي ؟ *

- نعم
- لا

3. في أي قسم تدرس؟ *

- ◯ هندسة حاسب
- ◯ علوم حاسب
- ◯ نظم معلومات

4. هل تواجه صعوبة في التواصل مع الطلاب ؟ *

- ◯ نعم
- ◯ لا

5. هل تجد صعوبة في طلب المساعدة من الأخرين؟ *

- ◯ نعم
- ◯ لا

6. هل تتوفر لديك جميع إيميلات أساتذتك للترم الحالي؟ *

- ◯ نعم
- ◯ لا

7. هل إيجاد مصادر تقدم شروحات جيدة للمواد يستغرق منك وقت وجهد للبحث ؟ *

- ◯ نعم
- ◯ لا

8. هل سبق واستعرت كتب من احد الطلاب ؟ *

- ◯ نعم
- ◯ لا

9. ماهي أفضل طريقة للتعامل مع الكتب التي انهيت دراستها؟

*

- [ ] التبرع بها
- [ ] بيعها بسعر مخفض
- [ ] اعارتها
- [ ] Other

10. برأيك ما السبب الذي يمنع الطلاب من شراء الكتب والمراجع ؟

*

- [ ] تكلفتها عالية
- [ ] الحاجة الى جزء فقط من المرجع
- [ ] ليست جميع الكتب متوفرة
- [ ] Other

11. هل سبق وسمعت مصطلح في علوم الحاسب أثار فضولك واردت معرفة ماهو المنهج الذي تناول هذا المصطلح؟ *

- نعم
- لا
- ربما

12. * هل يهمك المشاركة في مجموعات للدراسة في موادك ؟

- نعم
- لا

Submit

Never give out your password. Report abuse