Optimizing University Attachments using a Web-Based System for Streamlined Document Collection and Planning

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Declaration and Approval

We declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of our knowledge and belief, the research proposal contains no material previously published or written by another person except where due reference is made in the research proposal itself.

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Abstract

The process of planning and documentation of student attachments in universities can be a time-consuming and challenging task. The evaluation procedure involves site visits and manual submissions of document reports. Planning site visits poses logistical difficulties due to ineffective communication. In addition, the submission of hardcopy reports leads to long-term environmental degradation. This project aims to alleviate these problems by developing an attachment system to automate the process. The proposed system is designed to address gaps in existing solutions by offering novel features, such as a platform for the online documentation of weekly logs and reports. Additionally, it will enable synchronized planning and communication between the faculty supervisor and the student using a coordinated calendar and chatting module, among other features. The system will benefit universities significantly, including improved document management, increased efficiency, and seamless organization of the attachment process. The proposed solution aligns with SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). In general, the project will decrease the administrative workload for staff and result in a more positive experience for students.

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List of Abbreviations

CSS – Cascaded Style Sheets

DCL – Data Creation Language

DDL – Data Definition Language

DML – Data Manipulation Language

ERD – Entity Relationship Diagram

HTML – Hypertext Markup Language

IDE – Integrated Development Environment

REST – Representational State Transfer

SDG – Standard Development Goal

SSAD – Structured Systems Analysis and Design

UI – User Interface

XP – Extreme Programming

Chapter 1: Introduction

1.1 Background Information

Industrial attachment refers to a structured and academic-credit-earning opportunity offered by many higher learning institutions to allow students to gain practical work experience within a professional environment (Kiplagat et al., 2016). Dondofema et al. (2020) state that industrial attachment programs establish a unique connection between theoretical knowledge and practical work, bridging the gap between academia and the profession.

To assess a student's industrial attachment, universities apply various techniques. Among them are site visits, where supervisors visit the students at their workplace to observe their level of engagement, professionalism, and application of knowledge in real-world settings (Enhanced Education Group, 2018). Additionally, universities often request feedback from the students' supervisors in the industry. Students are also typically required to submit reflective reports detailing their experiences, challenges, and lessons learned during the industrial attachment. These reports are then gauged to determine students' ability to connect their practical experiences with theoretical knowledge (Khumalo & Dewah, 2018).

The industrial attachment process is not without its pitfalls, particularly in the assessment mechanism. The submission of reports is cumbersome for both students and university faculty. Typically, this involves the submission of physical copies that necessitate individual verification before they can be considered for evaluation. Because of the time-consuming process of individual verification, a substantial amount of the faculty's time is consumed, often spanning multiple days. In addition, the adequate assessment of an industrial attachment necessitates effective communication among the supervisor, employer, and student (Abdullahi & Othman, 2022). This requirement gives rise to various logistical challenges, such as establishing suitable communication channels and coordinating on-site meetings for evaluation purposes.

The gaps in the industrial attachment process need to be addressed. Introducing an alternative to the traditional physical submission of student reports holds the potential to save significant time and resources for institutions. Automation of the verification process would liberate universities' staff to engage in other productive endeavors. Moreover, mitigating the paper footprint of universities aligns with SDG 13, which pertains to climate action. Furthermore, establishing a synchronized platform for seamless communication and planning between supervisors and students would enhance the efficiency and ease of the overall process.

Therefore, the primary objective of this research is to assess the efficacy of a web-based attachment system that emphasizes document collection and synchronization functionalities in resolving the challenges associated with the attachment process. The study hypothesizes that the proposed system will substantially enhance the industrial attachment process by eliminating the requirement for physical report submissions, automating the verification of reports, and facilitating streamlined planning and communication among all relevant stakeholders.

1.2 Problem Statement

The submission of attachment documents at universities is still largely manual. This results in frustration from students and administrators managing the attachments. Moreover, the scheduling of attachment reviews is tracked offline, creating an avenue for confusion. To address this problem, there is a need to leverage an optimized web-based solution that optimizes document collection and improves the efficiency of synchronized planning.

Existing solutions lack methods to check if the documents fit the minimum requirements as stipulated by the guidelines. This is a huge challenge as problems detected through manual submission incurs a considerable cost for the students that are required to reprint their documents to fit the guideline requirements. Moreover, the writing of weekly logs of day-to-day attachment activities is usually done manually, which may be imprecise as there are no means of testing the validity of the records. Lastly, there is no means of communication between the faculty supervisor and the students via most systems to resolve planning logistics.

Hence there is a need to develop a means of validating and documenting submitted reports. Furthermore, implementing a chat feature to communicate the booking of supervisor visits and a module for the synchronization of calendar events is of utmost importance.

1.3 Objectives

The objectives of this research include:

1.3.1 General Objective

To develop a web-based attachment system with a focus on document collection and planning features that will address the problems in the university-industry attachment process.

1.3.2 Specific Objectives

i. To analyze the current procedures in the industry attachment domain.
ii. To review the challenges caused by the current approach to the attachment process.
iii. To study and evaluate how similar works have handled protocols and mechanisms in the attachment process.
iv. To develop a web-based attachment system for universities based on our findings.
v. To test and validate the proposed attachment system.

1.4 Research Questions

The research questions are as follows:

i. How have current procedures been implemented in the industry attachment domain?
ii. What challenges have been caused by the current approach to the attachment process?
iii. What protocols and mechanisms have been applied to the attachment processes?
iv. How can a web-based attachment system for universities be designed?
v. How can the proposed attachment system be tested and validated?

1.5 Justification

As proposed by Gashaw, (2019), costs must be managed and minimized to promote sustainability attached to attachment programs. The financial cost of reprinting reports is a hefty amount for students that do not meet the required threshold for submission guidelines. This is a clear indicator of paper wastage that has long-term environmental costs. According to a survey conducted by (Mukete et al., 2014) that examined the presentation of reports in universities, over 16000 students prepared project reports of about 120 pages annually. This sums up to about 1,920,000 papers annually without factoring in reprints. One of the leading solid waste components of landfills is paper waste amounting to about 26 million tons (Smith, 2011; Forestindustries, 2013). Paper decomposition produces a gas known as methane that is twenty-three times more potent than carbon (IV)oxide, thus one of the largest emitters of greenhouse gases that harm our environment (Asi & Busch, 2011; Skogsindustrierna, 2013).

According to conclusions made by (Mukete et al., 2016), implementing digital systems in institutions that assist in minimizing paper consumption in any areas facing dire environmental challenges is paramount. Therefore, universities need to implement a system to reduce paper wastage, especially during the manual submission of attachment report documents. This solution can be implemented using an Information Technology system that eradicates the need for paper usage. This will, in turn, promote sustainability through SDG 12, which aims to ensure responsible consumption of resources to reverse harm inflicted on our planet.

1.6 Scope and Delimitations

1.6.1 Scope

The proposed web-based attachment solution will cover user authentication, record keeping, document collection and verification, real-time chatting, location tracking, calendar schedule management, and user data collection. The study will be conducted within one school semester, 14 weeks. This timeframe considers factors such as data collection, system development, implementation, and evaluation.

1.6.2 Delimitations

1.6.2.1 Technical Implementation

The study will focus on the conceptual design and development of the web-based attachment system. However, due to resource and time constraints, the actual implementation of the system on a large scale or integration with existing university systems is outside the scope of this research.

1.6.2.2 External Stakeholders

While the research will involve understanding the challenges faced by students, universities, and industry partners, it may not extensively explore the perspectives and requirements of other external stakeholders, such as regulatory bodies or government agencies.

1.6.2.3 Long-term Implementation and Sustainability

The study will mainly focus on the development and initial implementation of the web-based attachment system. Long-term implementation, scalability, and sustainability aspects may be considered but will not be the primary focus of this study.

1.6.2.4 Comprehensive Supervisor Features

The study will not include certain supervisor features because of the limited time for implementation. It will not have a module for host supervisors, nor will it cover the assigning of faculty supervisors to students.

1.7 Limitations

The web-based attachment system relies on stable and reliable internet connectivity. However, variations in internet access, network outages, or limited bandwidth could hinder the system's accessibility and usability, particularly in areas with poor internet infrastructure.

The study's findings and efficacy assessment may be specific to the educational institution, industry settings, or cultural context in which the research is conducted. The generalizability of the results to other institutions or industries may be limited, as different contexts could have unique challenges and requirements.

The study's outcomes may be influenced by factors beyond the researchers' control, such as changes in educational policies surrounding Industrial Attachment

Chapter 2: Literature Review

2.1 Introduction

This section covers the literature review of the research study. It will begin by examining existing literature concerning the current procedures in the industry attachment process. It will briefly cover the existing structure and policies of industry attachment and assess their merits and demerits. The segment will then detail the challenges posed by the current way of doing things in the industrial attachment domain, highlighting the pitfalls of certain practices. Subsequently, works related to our proposed solution will be analyzed. The study will detail their functionalities and strengths and illuminate the gaps they fail to address. Finally, this section will provide a conceptual framework for our proposed solution, showing the flow of information across our system.

2.2 Current Procedures in the Industry Attachment Process

Industrial attachment refers to a structured program facilitated by educational institutions wherein students can acquire practical work experience within a professional environment while earning academic credits ((Kiplagat et al., 2016; Dondofema et al., 2020). According to Khumalo and Dewah (2018), this initiative serves as a means for students to apply their theoretical knowledge in real-world scenarios, establishing a connection between their academic studies and the practical demands of the industry. Chun et al. (2020), concur with this sentiment stating that, through industrial attachments, the divide between academia and the professional sphere is bridged, allowing students to gain valuable experience and enhance their understanding of the industry.

Although the specifics, differ across organizations, the basic structure of the industry attachment and the roles of the relevant stakeholders remain constant. As specified by both Enhanced Education Group (2018) and Wilson (2016), the faculty supervisor assumes the responsibility of visiting the student during their industrial attachment, addressing any concerns raised by the attaché or site supervisor, evaluating the student's performance based on the completion of agreed-upon assignments, and grading the attachment report.

Several Universities such as Strathmore University (2022) and Makerere University (2020) expect the attaché to actively seek on-site supervision from their supervisors and fulfill the academic tasks mutually agreed upon by them and the university (for example logs and reports). In most cases, the assessment of industrial training performance is based on various factors, including the activities logbook that students maintain, their final report detailing their industrial training experience, the report provided by the industrial training supervisor, or company feedback report from the training placement, and the evaluation and feedback provided by industrial training lecturers through site visits or surveys (Enhanced Education Group, 2018; Strathmore University, 2022; Dondofema et al., 2020).

The current industrial attachment process offers several advantages to students and educational institutions. According to Khumalo and Dewah (2018), the structure of industrial attachments enhances students' understanding of the practical demands of their field and enables them to acquire valuable skills and experience. Dondofema et al. (2020) highly commend the involvement of faculty supervisors in the attachment process, noting their role in quality assurance and attaché guidance. Additionally, the evaluation process as endorsed by the Enhanced Education Group (2018) and several other institutions such as Strathmore University (2022) is quite comprehensive, combining both supervisor insight and the assessment of several reports and logs.

2.2.1 Challenges in the Current Processes in the Industry Attachment Process

According to the Enhanced Education Group (2018), the effectiveness of the Industrial Attachment experience is significantly impacted by the interplay among the student, site supervisor, and faculty supervisor. This collaborative partnership plays a pivotal role in facilitating the achievement of the attaché's intended learning outcomes and maximizing the rewards garnered from this experiential endeavour (Chun et al., 2020). However, there is little to no provision for communication among them in the current management structure. This is particularly true for the faculty supervisor and the student who is not working in proximity during the time of the attachment. In a study by Gashaw (2019), it was determined that the internship encountered numerous challenges, notably the absence of sufficient guidance and support provided to students throughout their internship period.

Institutions such as Strathmore University (2022) and Makerere University (2020) include a mandatory site visit by the faculty supervisor as part of their attachment evaluation process. Dondofema et al. (2020), endorses regular supervision visits from training institutions to students on attachment. They propose that frequent supervisor visits enhance the effectiveness of the industrial attachment program due to the provision of instant feedback. Supervisor site visits are an integral part of the attachment process which is why it is quite an oversight that there are limited solutions that allow for synchronized planning of such visits between the supervisors and the student.

As a key player in the advancement and progress of individuals and societies, the university carries the responsibility of incorporating the essential concept of sustainability into its practices and curricula (Mian et al. 2020). Effective management and minimization of costs associated with each program are imperative for ensuring sustainability. Industrial attachment involves both direct and indirect costs that are borne by the students, institutions, and host organizations (Gashaw, 2019). Of interest in this study is the fact that in many institutions, the submission of the pertinent documentation is done physically generating a lot of paper waste.

When considering the additional costs associated with paper use, various factors come into play. This includes the financial costs of items utilized in conjunction with paper, such as printers, printer ink, paper clips, folders, and pens (Yale Sustainability, 2022). Storage considerations and the time and energy required to file and find paper documents also contribute to the overall costs of paper usage (Yale Sustainability, 2022). From an environmental perspective, the paper industry ranks as one of the top three industries causing pollution to the air, water, and land not to mention its role in fast-tracking deforestation (Aydin, 2022).

It is also important to consider time constraints as part of the cost of the attachment process. Universities often detail specific requirements for their student's reports for example those given by Makerere University (2020). The individual verification of these requirements upon submission is very time-consuming, sometimes spanning several days. A system must be created to automize the confirmation of these prerequisites.

2.3 Related Works

2.3.1 Strathmore Attachment System

The Strathmore University Attachment System is a web-based attachment management system that serves Strathmore University. The application offers several functionalities to its users. First, the system has an intuitive user interface powered by HTML and CSS. Students can utilize the system to submit attachment applications for approval and track the status of their applications. Once approved, students can access comprehensive details about their attachments, including their grades. The host supervisor can assess the student's performance by submitting an evaluation form through the system. Similarly, the faculty supervisor can access the student's attachment details and submit their assessment using the system.

While the system has a wide range of capabilities, there are some issues it does not address. The system does not offer an online platform to submit reports and logs forcing its users to submit them manually. The system also lacks a communication module for correspondence between users. The users are forced to find other means of communication since there is no point of contact offered by the application.

2.3.2 iPrentice: An Industrial Attachment Management Solution

iPrentice is another web-based industrial management solution that can be curated for various tertiary institutions. This system offers a more comprehensive list of features than the Strathmore Attachment System. To begin with, the students can submit their reports on the system without the need for manual documentation. In the same vein, the student can maintain an e-logbook where they update their weekly or daily logs. The host supervisor can assess the student via the system and even provide feedback. The faculty supervisor can track the e-logbook of the students to gauge the ongoing suitability of the students' activities. In addition to that, the faculty supervisor is also able to mark the submitted reports on the system and give the student feedback.

Some of the gaps that iPrentice does not address, however, are the need for communication and document verification. Other than the feedback supervisors offer upon marking reports and e-logbooks, there is no more contact. The system does not have communication or planning modules. The reports that students submit via the system are also not automatically verified in any manner. As such the faculty supervisor still must check that the documents have fulfilled the required prerequisites.

2.3.3 Microservices-Based Student Industrial Attachment Information System

This is yet another web-based attachment management system developed by Esaida (2021). Esaida (2021), implemented the system’s functionalities as independent microservices loosely coupled using network protocols. The UI was implemented using React JavaScript, and the attachment and reports microservices were executed using Python Django framework and Django REST framework. The system allows the users to apply for attachments and update their logbooks. The supervisors can view the logbook and assess it via the system.

This system does not have the functionalities of report submission or verification. It assumes the use of logbooks as the only means of assessment. There is also no communication module between the supervisors and the student. All dialogues and discussions are expected to be carried out outside the system. However, the scalability of the solution is commendable.

Esaida (2021) successfully utilized container platforms to achieve scalability by effectively deploying microservices.

2.4 Gaps in Related Works

The three applications offer varying degrees of functionalities to their users. However, across all three, there is a need to improve document handling. None of the applications has a comprehensive suite of services that allow the student to update their logs based on instructor-provided prompts or submit their final reports via the system. All three solutions fail to implement a document verification feature which forces faculty supervisors to personally confirm aspects such as the page or word count after the report has already been submitted. A verification feature would perform this task and inform the student of any issues upon submission.

None of the three applications provides communication or synchronization services. For all three implementations, the stakeholders are expected to find other modes of communication outside the system. An all-inclusive system of such a nature would include aspects such as a chatting module, synchronized calendars showing important dates, and a mapping feature just to name a few. Such gaps in existing solutions need to be addressed.

2.5 Conceptual Framework

The users (faculty supervisors and students) can be authenticated into the system and access their relevant modules. The student can apply for an attachment by posting the pertinent details about it on the system. The faculty supervisors (already assigned) will review the applications and either accept or reject them. The status of the application will be updated accordingly on both the student’s and supervisor’s ends. During the attachment, the student will update their weekly logs using the provided form. They will be able to fill in the information and even provide supporting images or videos.

The supervisor will be able to view the weekly logs and will have the option of providing feedback to the student. More in-depth communication, for example, that is needed to plan a site visit, will be carried out on the chatting module of the system. Planning activities will also be carried out using system calendars and maps to make the whole process as seamless as possible. The calendars will also be used to remind students of important dates such as reports and log submission deadlines.

Finally, the system will allow the student to submit their attachment reports as pdfs. The system will provide automatic verification of aspects such as the word count and page count and provide the student with the information. The student will then be able to revise their submission accordingly. On their end, the faculty supervisor will be able to view the document on our system and assess it. They will assign the marks to the student for their weekly logs, site visits, and overall report. The faculty supervisor can then specify the weights of the various assessments and the system will then calculate the student's final grade. This grade will be viewed by both the supervisor and the student.

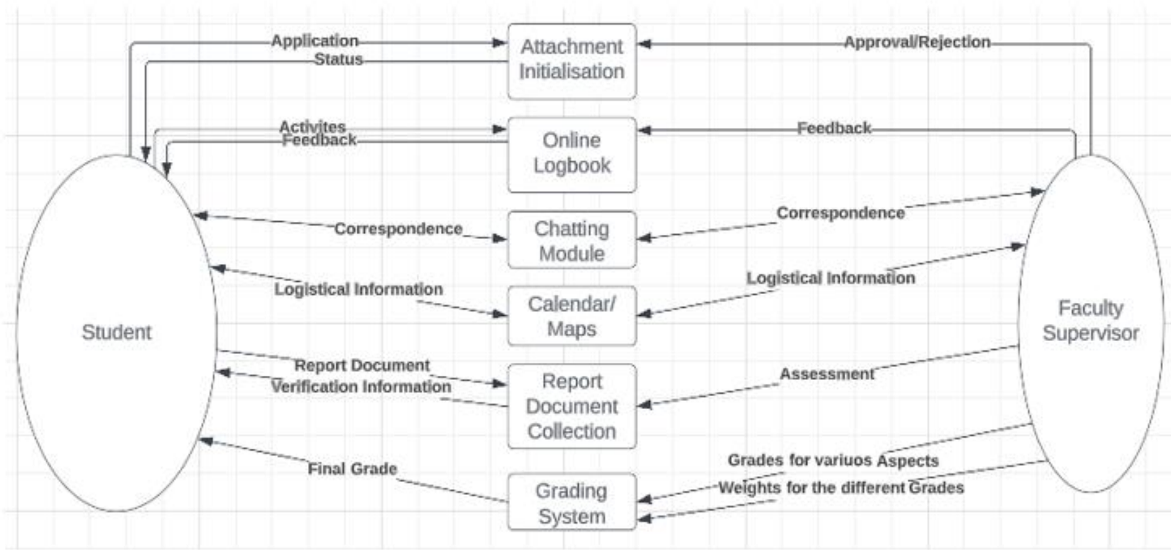

Figure 2.1 Conceptual Framework

Chapter 3: Methodology

3.1 Introduction

This section aims to highlight the methodology that will be conceptualized for this project. It discusses the choice of system development methodology and the justification for it. Furthermore, examines the phases that will be applied to the methodology using a diagram approach. Lastly, it considers the deliverables and tools, and techniques for this project. The development paradigm considered for this solution is SSAD as it follows a structural and process-oriented approach.

3.2 System Development Methodology

The proposed system development methodology to be utilized for this research topic will be the Agile methodology. Agile methodology is a conceptual framework that follows the approach of a planning phase and follows the path toward deployment with incremental and iterative interactions throughout the project's life cycle (Al-Saqqa et. al, 2020). It is a lightweight, adaptive-to-change model that can evolve quickly to reflect changing needs while reducing overheads. According to Al-Saqqa et al. (2020), this is achievable through the principle of delivering working software quickly with a preference for a shorter time scale.

Agile development methods are broad hence this project will aim to achieve the Extreme Programming development methodology as a category under agile development. This methodology will cater to our proposed IT solution that attempts to develop a web-based platform that streamlines and optimizes the university attachment process via enhanced document collection and planning.

3.2.1 Justification of the Methodology

The favored methodology for this project, Extreme Programming (XP), focuses on two main practices that will be essential for this project: pair programming and refactoring. Firstly, pair programming is suitable as two developers work on the project, one writing code and the other reviewing it. This is advantageous to the project framework that recommends the solution to be developed in pairs.

Secondly, the refactoring practice works as a tool to improve the overall software by molding it to be maintainable and simple by reconstructing code without changing its functionality (Schmidt & Schmidt, 2016). Extreme Programming breaks down the development cycle process into small manageable segments and as a result, the cost of change is reduced (Merzouk et al., 2018). Consequently, this is suitable as it is a low-risk methodology for the proposed project that will be developed in a short time frame while ensuring software quality and customer satisfaction.

3.2.2 Methodology Diagram

The figure below Figure 3.1 demonstrated the Extreme Programming (XP) life cycle that spans six phases namely: exploration phase, planning phase, iteration to release phase, productionizing phase, maintenance phase, and lastly death phase.

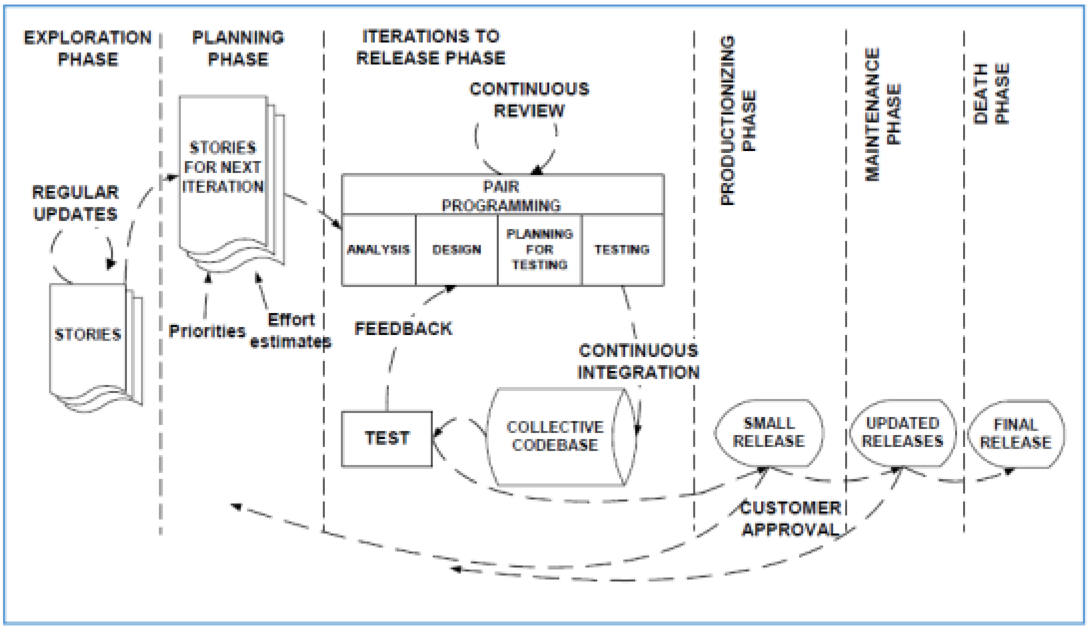

Figure 3.1 XP Methodology Diagram (Al-Saqqa et al., 2020)

The Extreme Programming (XP) development cycle is discussed in depth below.

3.2.2.1 Exploration Phase

This is the starting phase of the Extreme Programming development life cycle. It involves collecting user stories from customers containing requirements and features. Additionally, the developing team gets accustomed to the various tools and processes that will be used in the project. This phase is important as it explores a sample prototype that will test the possible architecture. This phase is proposed to last a few weeks with regular updates.

3.2.2.2 Planning Phase

Next, the planning phase involves creating a strategic schedule and estimation of the development timelines. This process takes a few days at most, and the user stories are given priority in planning. This phase is crucial as it provides a clear guideline for the development time constraints for each iterative task.

3.2.2.3 Iteration to Release Phase

This phase involves actual development that takes place in several iterations. At the end of each iteration functional tests are to be carried out to ensure customer satisfaction. This will involve a lot of feedback to ensure the project is ready to move forward into the next phase at the last iteration. This project will use the SSAD paradigm that follows a structural approach to developing the solution. For example, Table 3.1 below shows the SSAD diagrams promised to be delivered using Chapter 4.

Table 3.1 SSAD Analysis and Design Diagrams

SSAD Diagrams	
Analysis Diagrams	**Design Diagrams**
• Use Case	• Database Schema
• ERD	• UI Mockups- wireframes
• Sequence Diagrams	• System Architecture
• Class	
• Activity	

3.2.2.4 Productionizing Phase

This phase involves deploying the product and delivering it to the intended target/client, however, additional testing and evaluation of the system performance prior should be considered. This will ensure that the quality of the product is evaluated before handing it over to the client.

3.2.2.5 Maintenance Phase

This phase involves incorporating new user stories that may come after the first release of the product. It allows the integration of changes in the form of updates to improve the quality of the product.

3.2.2.6 Death Phase

Lastly, this phase suggests that no further changes are to be made to the system as all user needs and requirements have been fulfilled thus any further development changes would be costly to introduce into the system.

3.3 Deliverables

The deliverables for this project are listed and discussed as follows.

3.3.1 Model and User Interface

The model interface will provide a visual representation or blueprint of the features, structure, and relationships between the components represented in the system. This is necessary as it will enhance the system analysis and design process by exploring system behavior. The User Interface will act as a visual point of interaction between the system and the user to promote a satisfactory user experience.

3.3.2 Proposal

The proposal will serve as an artifact of documentation. It will highlight the reasons why the proposed research topic was carried out. It will serve as a means of communication, planning, accountability for evaluation, and decision-making. This will ensure the credibility and professionalism of the research being conducted.

3.3.3 Distributed System

Lastly, a distributed system that can be accessed through different nodes will be delivered as the final product. The distributed system will enhance concurrency, scalability, and communication. This is beneficial as it enhances the overall performance of the system.

3.4 Tools and Techniques

3.4.1 MySQL

The Database Management System (DBMS) that will be used to manage data for this project is MySQL. According to Ohyver et al. (2019), MySQL is a relational database server that supports SQL (Structured Query Language). Ohyver et al. (2019), adds that it is an open-source database that is compatible and reliable with major if not all hosting providers making it easy to manage and cost effective to use.

3.4.2 Visual Studio Code

Visual Studio Code is the Integrated Development Environment (IDE) that will be used to develop the code solution. IDEs are software applications that integrate the tools required for a software development project such as an editor, compiler and debugger thus consolidating different aspects of software development and remarkably improving programmers' productivity (Tan et al., 2023).

3.4.3 GitHub

Developers rely on automation tools to decrease intensive workload such as performing repetitive tasks to check whether code builds, tests pass, and contributions satisfy the defined style guidelines (Kinsman et al., 2021). GitHub is the platform that will be used for version control to reduce workload for this project. According to Kinsman et al. (2021), GitHub actions through triggers (e.g., pull requests, commits) permit the automation of tasks that can be shared among repositories simplifying how developers build, test and deploy software projects. This will benefit the project by allowing ease of collaboration, tracking of changes, branching, merging, and rolling back of code.

Chapter 4: System Analysis and Design

4.1 Introduction

This section explores the system analysis of the attachment management system under the SSAD design paradigm. To this end, the chapter will discuss the functional and non-functional requirements of the system. Additionally, system analysis diagrams and system design diagrams are provided. The diagrams drawn under system analysis include the use case diagram, sequence diagram, Entity Relationship Diagram, class diagram and the activity diagram. Under system design, the database schema, UI mock-ups and system architecture diagrams have been illustrated.

4.2 System Requirements

Some of the system requirements reviewed for our project include:

4.2.1 Functional Requirements

i. Authentication module- this module is a security plug-in that will be used to verify the user profiles that exist in the system against entries in the database. This module will include a registration section to collect information about the user while the login section will be used to authenticate the user using a unique ID which is the email address and their password. This module will be developed using Laravel’s breeze that implements features for login, registration, password reset, hashed passwords, password confirmation and email verification.

ii. Logbook module- this module provides features for documentation of weekly logs that entail the activities carried out by the student during the attachment period. The student user will interact with this module by recording their daily activities. The supervisor user will interact with this module by providing feedback regarding the student’s activities.

iii. Attachment initialization module- this module is necessary for attachment application and allocation. The student user will interact with this module by applying for an attachment. The supervisor user interacts with this module by verifying whether an attachment has been approved or not. This module includes supervisor allocations to students. The admin user will interact with this module by allocating a supervisor to one or many students.

iv. Attachment report collection module – this module supports the submission of pdf attachments by the student user. The supervisor user will interact with this module by downloading and reading pdfs offline or viewing the pdfs online via the system.

v. Chat module -this module is responsible for providing a platform for communication via the student user and the supervisor user. This feature will improve the correspondence between both users for seamless planning and clarification of any queries brought forward via the system.

vi. Grading module- The grading module oversees displaying the final grade of the student user. This will be achieved through automatic calculations by the system based on assigned marks and assessment weights. The supervisor will interact with this module by marking and assigning marks for the student user's weekly log, site visit and final report. The student will interact with this module by viewing their final grade.

vii. Admin module- this module will be used for ana overall view of the entire system by a super administrator. The super admin user will interact with this module by allocating a supervisor to many students as per attachment requests.

viii. Calendar – this module will integrate the Google Calendar API. This will improve the efficiency of planning for events such as site visits. The student user via the system can send out a calendar invite to the supervisor user to schedule a site visit meeting. The supervisor user can choose to accept or decline the scheduled invite. If the supervisor accepts then the scheduled event will automatically sync on both user's platforms while if decline, the student user will receive a notification to reschedule the event to a different date/time.

ix. Maps – this module will integrate the Google Maps API. The aim of this module will be to improve the site visit experience for the supervisor user as they locate the student users for on-site visits and assessments. Additionally, it will be possible to track the student user's movements during logged in attachment hours. The student user will interact with this module by sharing their live pinned location as per request by the supervisor. The supervisor user will interact with this module by searching for locations and viewing the student user's pinned location.

4.2.2 Non-Functional Requirements

i. Security: The system should enforce strong authentication measures to ensure that only authorized users can access and modify attachment-related information. Additionally, the system should have appropriate access controls to ensure that users can only access modules relevant to their roles and responsibilities.

ii. Usability: The system should have a user-friendly interface, ensuring ease of navigation and intuitive interaction for users with varying levels of technical expertise.

iii. Performance: The system should be capable of processing large file uploads efficiently.

iv. Compatibility: The system should be compatible with common web browsers (e.g., Chrome, Firefox, Safari) and operating systems (e.g., Windows, macOS, Linux). In the same vein, the system should be responsive and adapt to different screen sizes and resolutions, including mobile devices and tablets.

v. Interoperability: The system should support standard file formats (e.g., PDF) to allow users to submit and retrieve documents without compatibility issues. The system should also have APIs or integration capabilities to facilitate seamless integration with external systems or services (e.g., third-party document verification tools).

vi. Maintainability: The system should have modular and well-documented code to facilitate ease of maintenance and future enhancements. It should also allow for easy configuration and customization, such as modifying attachment metadata fields.

vii. User Support: The system should provide comprehensive documentation that describes the system architecture, modules, components, APIs, and dependencies to assist users in understanding and utilizing the attachment system effectively.

4.3 System Analysis Diagrams

4.3.1 Use Case Diagram

The use case diagram illustrated in Figure 4.1, demonstrates the steps in the business process represented by actors (external entities) that interact with use cases by initiating them. The actors defined in our system are the student, supervisor and admin actors while the use cases present within the system boundary are the sign up, log in, verify password, display login error, apply for attachment, verify attachment, assign supervisor, update logbook, submit report, grade report, use chat, share maps and use calendar use cases.

The interaction among use cases and actors is as described. First, the student actor initiates a sign-up use case. The log in use case can be initiated by the student, admin and supervisor actors. For authentication, the verify password use case includes the log in base case. Additionally, the display login error extends the login base case to throw an error in the event of invalid login details.

Next, the student actor initiates an apply for attachment use case. The admin actor initiates an approve attachment use case as well as an assign supervisor use case. The student actor then initiates the update logbook and submit report use cases. Both the student and supervisor actor can initiate the use chat, share maps and share calendar use cases. Finally, the supervisor initiates the grade report use case.

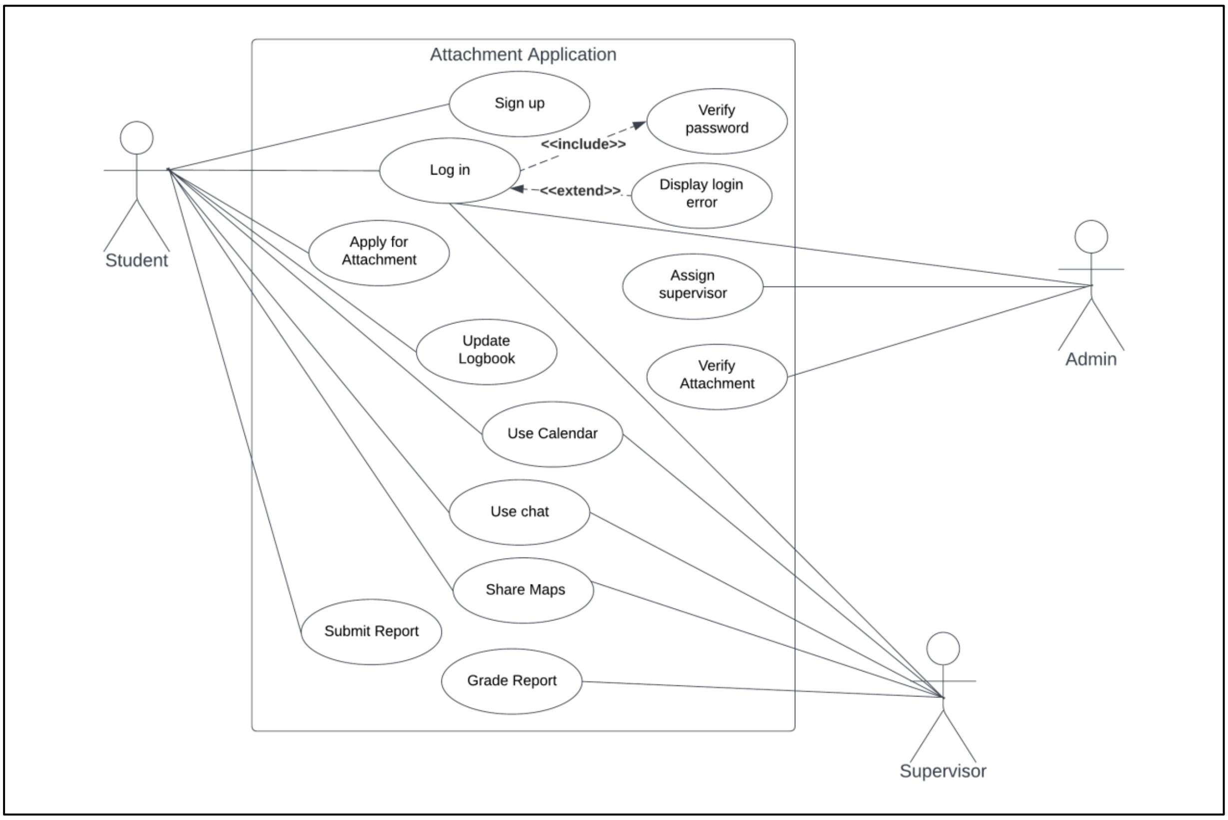

Figure 4.1 Use Case Diagram

4.3.2 Sequence Diagram

The sequence diagram, as shown in figure 4.2, illustrates the interactions and flow of events in the attachment management system. It showcases the key functionalities and communication between the student, faculty supervisors, and the system. The student initiates the application process by posting the pertinent details about the attachment on the attachment initialization sub-system. The faculty supervisors review the applications and either accept or reject them. The status of the application is updated on both the student's and supervisor's ends.

During the attachment, the student updates their weekly activities on the online logbook. The faculty supervisor has access to view the logs and may provide feedback to the student. For more in-depth communication the chatting module of the system is utilized. The student and faculty supervisor engage in discussions using the chat feature. Additionally, planning activities are carried out using system calendars and maps to ensure a seamless process.

The student submits their attachment report document. The supervisor is then able to view and assess the report. Finally, the supervisor assigns marks to the students for their weekly logs, site visits, and overall report. They have the option to specify the weights of the various assessments. The system calculates the student's final grade based on the assigned marks and assessment weights. The final grade is accessible to both the supervisor and the student.

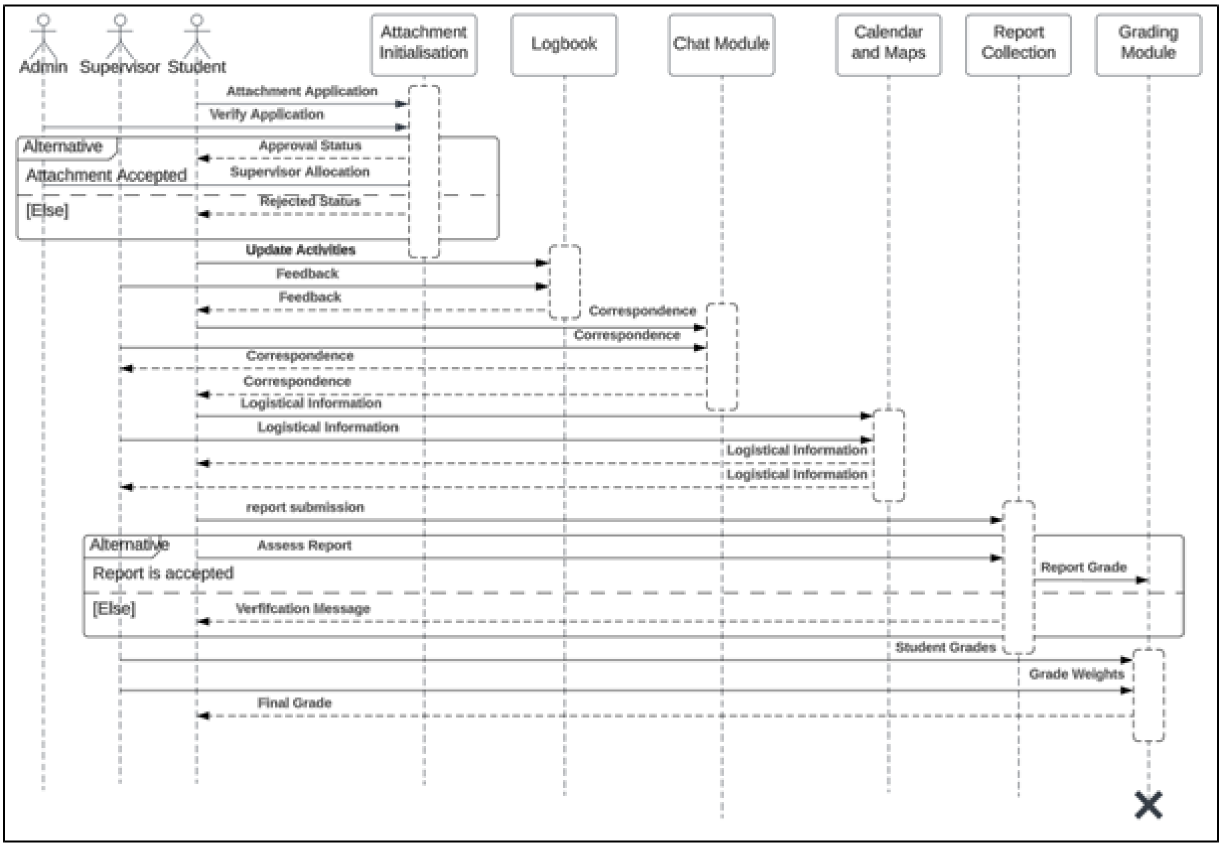

Figure 4.2 Sequence Diagram

4.3.3 ERD

The Entity Relationship Diagram (ERD) as shown in Figure 4.3 is a model that describes the logical relationship and interaction among entities in the system. This provides an overall blueprint for creating the physical data structures. According to the diagram the rectangles represent the entities while the diamonds represent the relationship among the entities.

The entities represented are the student, admin, supervisor, attachment, report and logbook entities. One and only one student applies for one and only one attachment. One and only one admin approves many attachments. One and only one admin allocates many supervisors. One and only one supervisor is allocated to many students. Furthermore, one and only one student updates one and only one logbook. Then, one and only one student submits one and only one report. Finally, one and only one supervisor grades many reports.

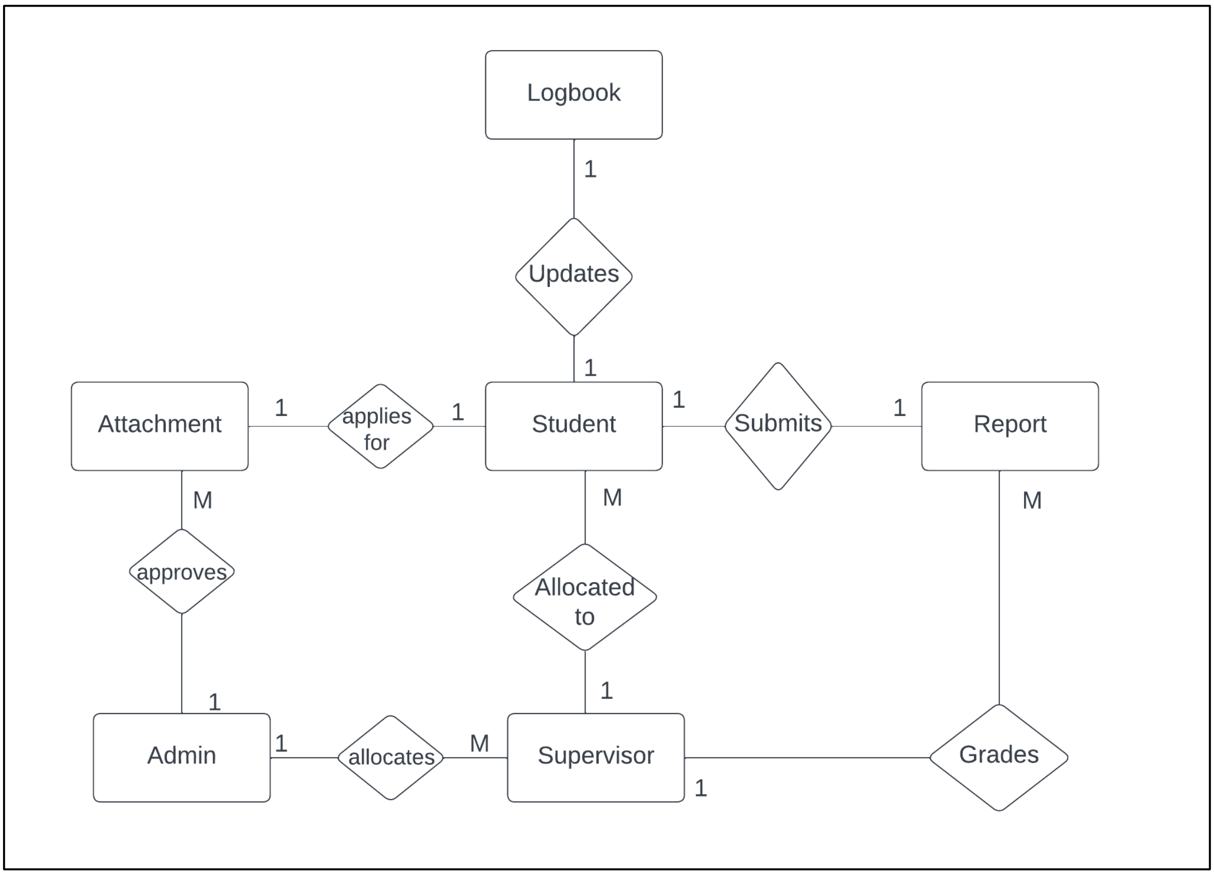

Figure 4.3 ERD

4.3.4 Class Diagram

The class diagram, as shown in figure 4.4, describes the attributes and operations of the classes in the attachment system. It also shows the constraints placed on the interactions between the different classes. The system has nine classes each with several specified functionalities and characteristics. The "Student" and “Supervisor” classes lie at the heart of the structure, representing the individuals who interact with the attachment system. These classes encapsulate attributes such as username, password and email address. They define important methods for user authentication, registration, and records management. In addition to these, the “Admin” class manages the allocation of students to supervisors, approval of applications and the addition of supervisors among other functionalities.

The "Attachment_Application" class, which is responsible for facilitating the attachment initialisation process, allows the student to apply for attachment approval and the lecturer to either approve or reject the application. It contains methods fetching the attachment details including the approval status. The "Logbook" class represents the weekly log kept by the student during the duration of their attachment. It maintains information such as the date of the log, its prompts, the student’s responses and the feedback of the supervisor.

To enable document management, the system implements the “Attachment_Report” class. This class is designed to manage document submission, verification and viewing. The "Chat_Module", “Maps” and “Calendar” classes serve as intermediaries between the “Student” class and the “Supervisor” class, facilitating comprehensive communication. They provide methods for synchronous textual communication, location sharing and scheduled notifications among others. Finally, the “Grading_Module” handles the assessment and evaluation procedures, allowing the supervisor to update student grades. The class also provides methods for the calculation of the student’s overall grade.

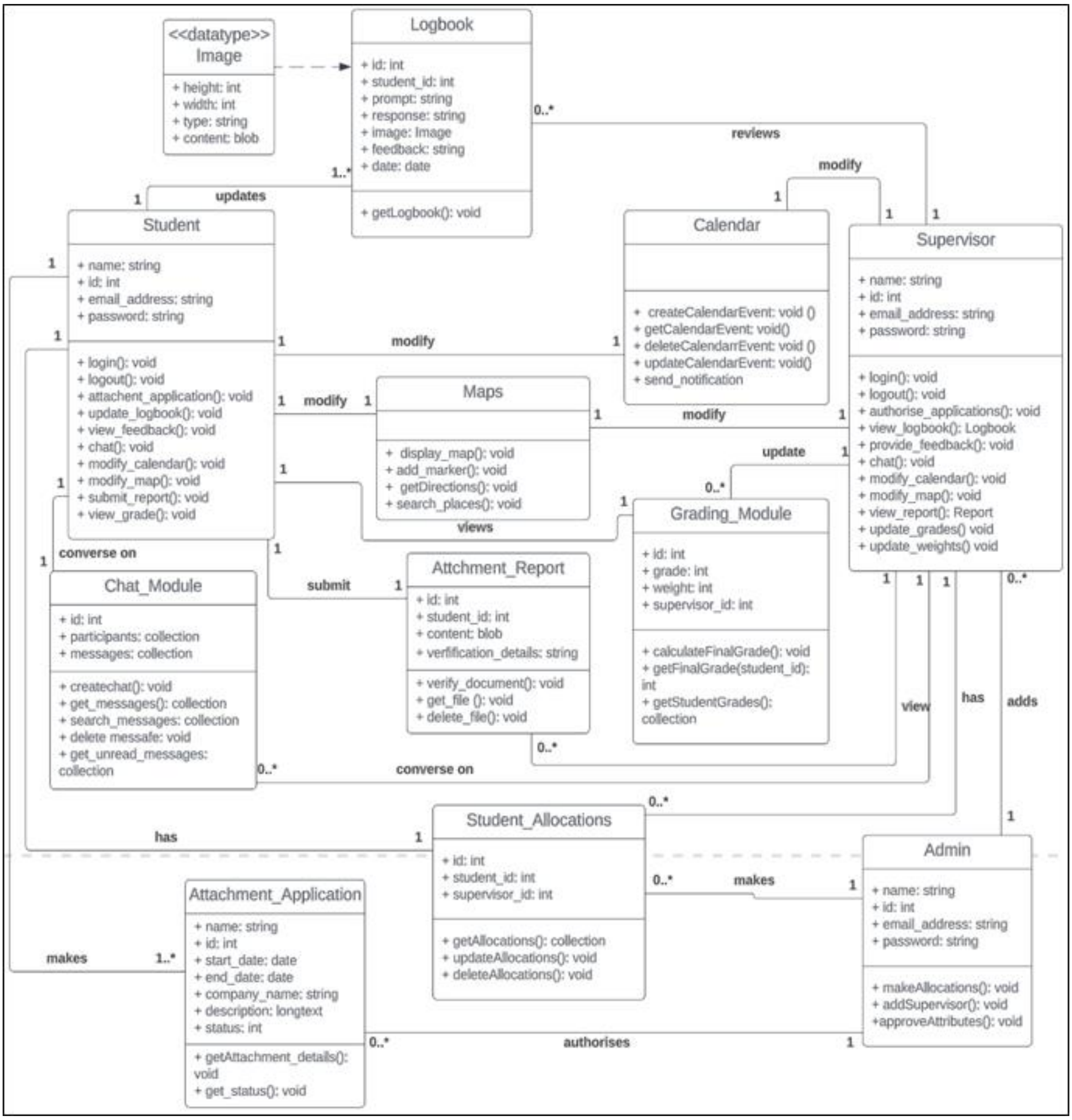

Figure 4.4 Class Diagram

4.3.5 Activity

The activity diagram illustrated in Figure 4.5 depicts the sequence of events for a student user as they interact with the system and identifies the outcome. From the initial state, the student user applies for an attachment by performing the student fills application form activity. If the application form is rejected, the student user performs the student fills application form activity till the application is accepted and the next activity can be performed. If the application is accepted, then the student user can perform the student updates weekly logs activity.

Next, when the student user requires a physical assessment for their attachment, they perform the student schedules site visit activity. Once the student user completes their minimum number of attachment hours then they perform the submit final report activity. If rejected, then the student user would need to perform the submit final report activity till it is accepted. If accepted, then the final state is achieved.

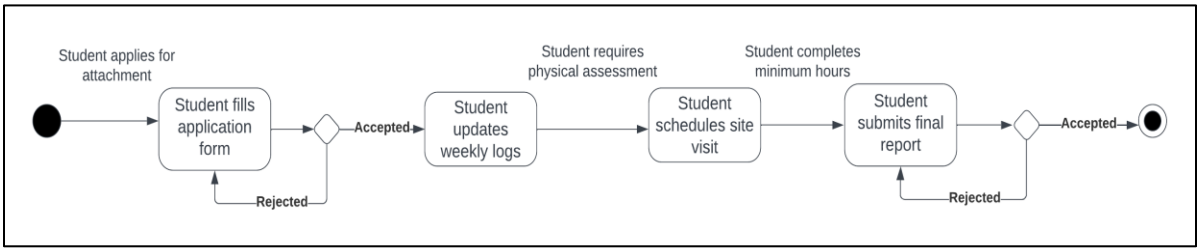

Figure 4.5 Activity Diagram

4.4 System Design Diagrams

4.4.1 Database Schema

The database schema, as shown in figure 4.6, provides a structured representation of the various entities, their attributes, and their relationships within the system. The schema showcases the entities relevant to our attachment management system, such as the users, reports, logbooks and results. Each entity in the logical database schema possesses a set of attributes that describe its characteristics. For instance, the "users" entity has the attributes: "id", "name", "email", "password", and "role". These entities are interconnected through meaningful relationships, reflecting the real-world associations and dependencies present in the university attachment process. Constraints are employed within the schema to uphold data integrity. These constraints include primary keys, foreign keys, uniqueness, and referential integrity.

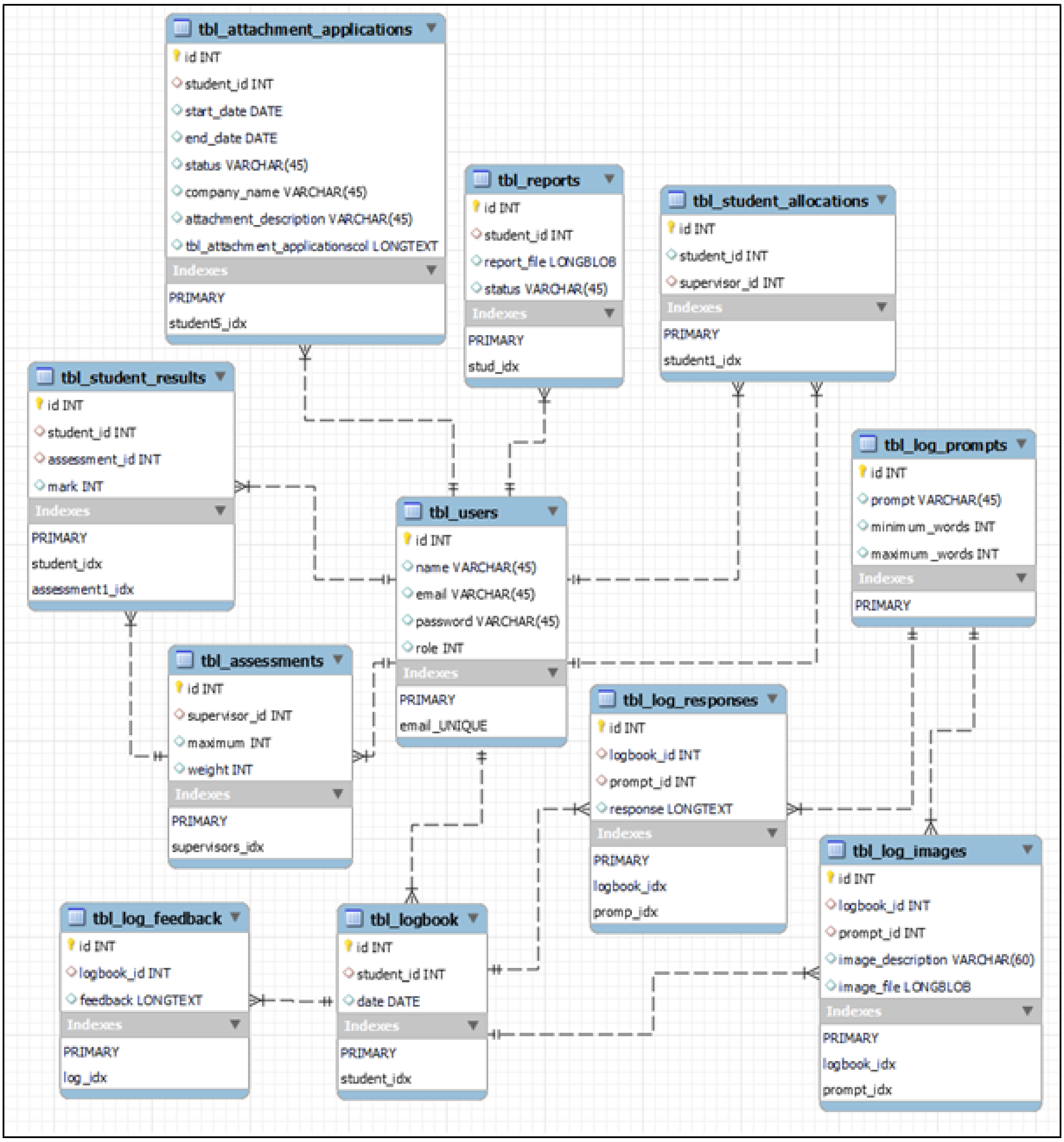

Figure 4.6 Database Schema

4.4.2 UI Mockups – Wireframes

The UI mockups represent a two-dimensional illustration of how components will appear on the system. This will serve as a visual blueprint of how the front end of the system will appear as a point of interaction between a human user and the screen. The focus in this case is the distribution of components considering the layout and spacing of elements to promote human interactivity and usability.

First, Figure 4.7 illustrates the login page wireframe having input fields for the user to login with their credentials to access the homepage. Next, Figure 4.8 illustrates the homepage layout with a menu and a few features such as a search bar, maps and calendar represented. Lastly Figure 4.9 represents a components key that breaks down a few of the components shown in the login and homepage wireframes.

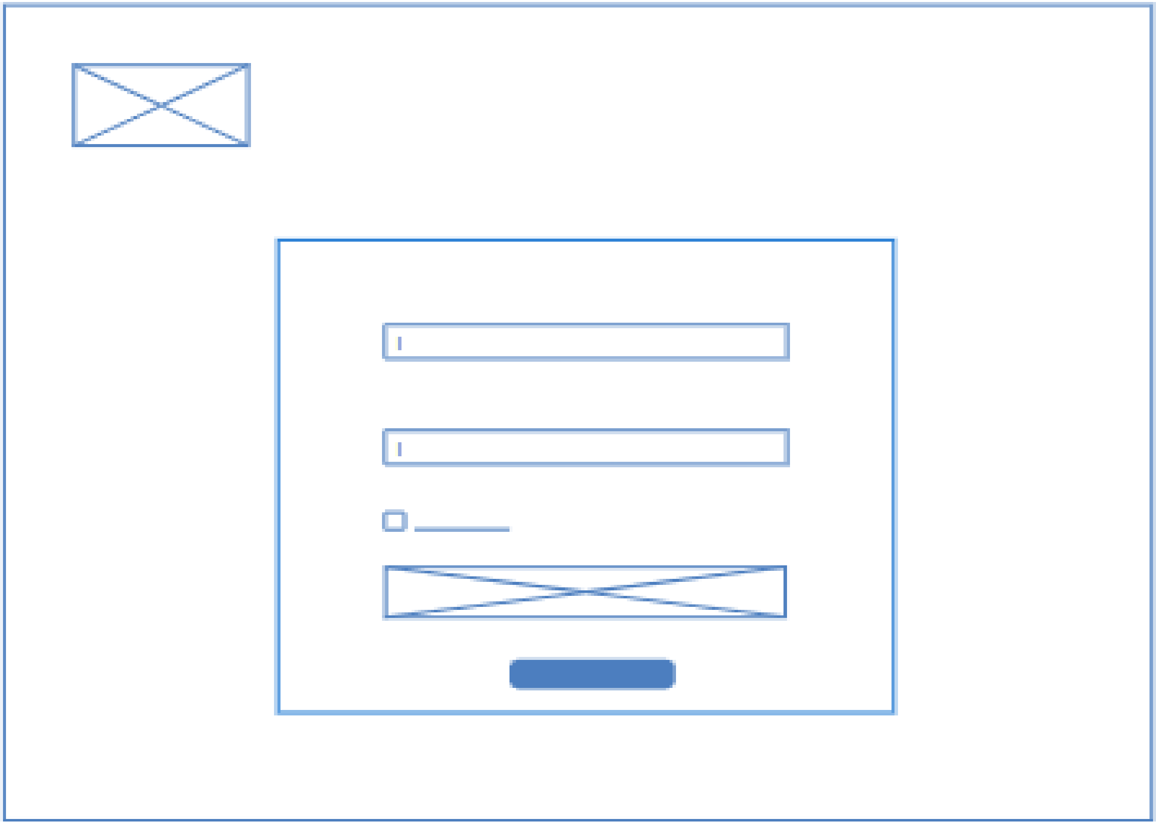

Figure 4.7 Login Page Wireframe

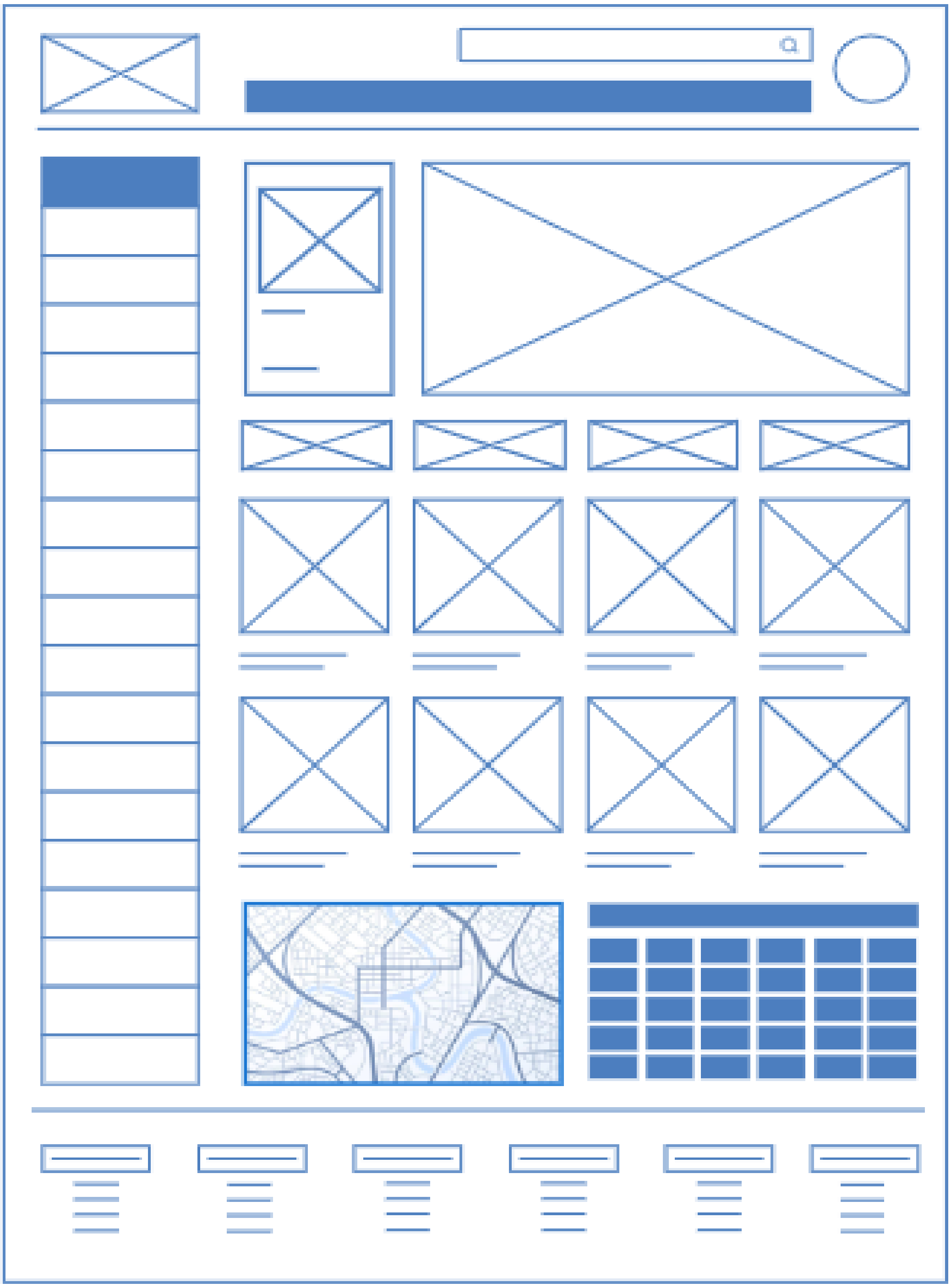

Figure 4.8 Home Page Wireframe

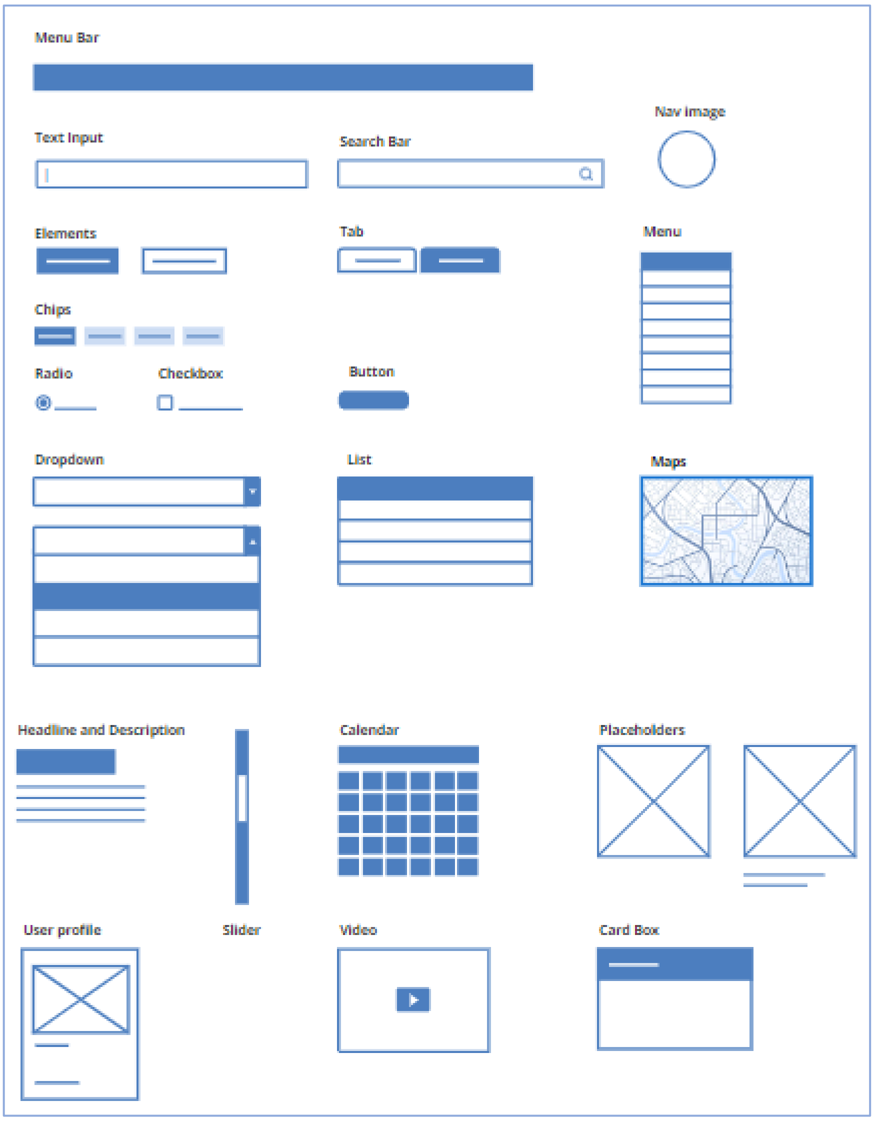

Figure 4.9 Components Key

4.4.3 System Architecture

The system architecture shown in figure 4.8 embodies an integral solution for efficient management and organization of attachments within a secure and user-friendly framework. Central to this system is the Attachment Management application, which interfaces with users through a web server. Through standard web browsers, users gain access to a range of functionalities, including document management and synchronized communication.

To augment the system's capabilities, it integrates with the Google Maps API and the Google Calendar API. The integration with the Google Maps API enables users to geographically tag attachments and visualize spatial data on interactive maps. Moreover, the Google Calendar API seamlessly integrates with the system, empowering users to associate attachments with specific events on their calendars, thereby improving organization and facilitating effective scheduling.

At the core of the system lies a robust MySQL database, serving as the central repository for persistent storage and management of attachment-related information. The MySQL database offers reliable data persistence and supports essential CRUD operations. This scalable and flexible database architecture accommodates a wide range of information, including documents, images, and multimedia files.

For real-time communication and collaboration, the system leverages the Pusher API to integrate chat functionality. Supervisors and students can engage in synchronous conversations, facilitating seamless planning and in-depth dialogue. Overall, the integrated components of the architecture synergistically work together to offer a comprehensive solution for attachment management, organization, and collaboration.

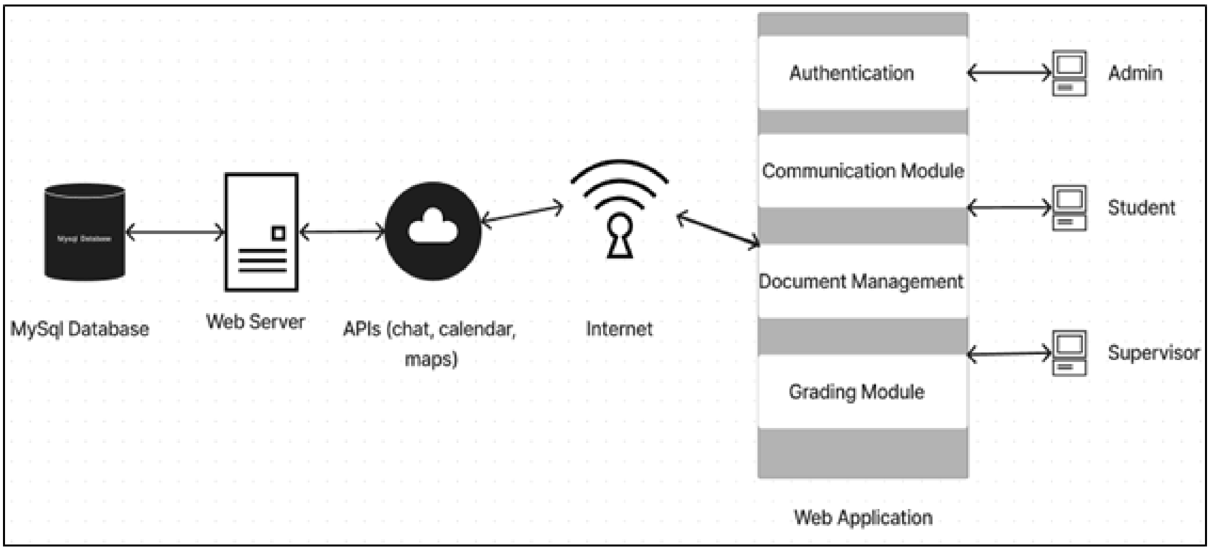

Figure 4.10 System Architecture

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Appendices:

Appendix 1. Gannt Chart