TRIBHUVAN UNIVERSITY

FACULTY OF HUMANITIES AND SOCIAL SCIENCES

LALITPUR ENGINEERING COLLEGE

LABXPLORER: INTERACTIVE LEARNING ENVIRONMENT

BY

SUSHANT BRAMHACHARYA (LEC077BCA08)

A PROJECT PROPOSAL

SUBMITTED TO THE DEPARTMENT OF COMPUTER APPLICATION

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR

THE DEGREE OF BACHELORS IN COMPUTER APPLICATION

DEPARTMENT OF COMPUTER APPLICATION

LALITPUR, NEPAL

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Tribhuvan University

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Submitted to

Department of Computer Application

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Submitted by

Sushant Bramhacharya (LEC077BCA08)

JUNE, 2024

Under the Coordination of

Er. Bibat Thokar

DECLARATION

I declare that the work hereby submitted for Bachelors in Computer Application at the Department of Computer Application , Lalitpur Engineering College entitled "**LabXplorer: Interactive Learning Environment**" is my own work and has not been previously submitted by me at any university for any academic award. I authorize the Department of Computer Application , Lalitpur Engineering College to lend this project work to other institutions or individuals for the purpose of scholarly research.

Sushant Bramhacharya (LEC077BCA08)

June, 2024

RECOMMENDATION

The undersigned certify that they have read and recommend to the Department of Computer Application for acceptance, a project work entitled "**LabXplorer: Interactive Learning Environment**", submitted by **Sushant Bramhacharya (LEC077BCA08)** in partial fulfillment of the requirement for the award of the degree of "**Bachelors in Computer Application**".

Project Coordinator

Er. Bibat Thokar

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BCA Program Coordinator

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Department of Computer Application , Lalitpur Engineering College

June, 2024

DEPARTMENTAL ACCEPTANCE

The project work entitled "**LabXplorer: Interactive Learning Environment**", submitted by **Sushant Bramhacharya (LEC077BCA08)** in partial fulfillment of the requirement for the award of the degree of "**Bachelors of Computer Application**" has been accepted as a genuine record of work independently carried out by the student in the department.

Er.Bibat Thokar
BCA Coordinator
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June, 2024

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I am also grateful to my classmates and friends for offering me advice and moral support. To my family, thank you for encouraging me in all of my pursuits and inspiring me to follow my dreams. I am especially grateful to my parents, who supported me emotionally, believed in me and wanted the best for me.

Sushant Bramhacharya (LEC077BCA08)

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ABSTRACT

LabXplorer is an innovative web application developed using the PERN (PostgreSQL, Express.js, React, Node.js) stack and Phaser.js, designed to revolutionize science education by providing interactive virtual experiments. This platform offers a user-friendly interface where students can conduct various experiments, track their progress, and showcase their scientific achievements. By leveraging real-time, visually engaging simulations, LabXplorer enhances students' understanding of scientific concepts through hands-on learning. The platform also supports collaboration and knowledge sharing via integrated discussion forums and messaging systems, fostering a community of inquisitive learners. Comprehensive feasibility studies, addressing technical, operational, and economic aspects, along with detailed system design diagrams, ensure the platform's robustness and scalability. Utilizing the latest web development technologies, including HTML5, CSS3, JavaScript, AJAX, and JQuery, LabXplorer delivers a responsive and efficient user experience. Rigorous unit testing, particularly on the authentication module, ensures security and reliability, making LabXplorer a dynamic, effective, and engaging tool for modern science education.

Keywords: *Interactive, Collaboration, Simulation*

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LIST OF ABBREVIATIONS

ACID	Atomicity, Consistency, Isolation, Durability
DFD	Data Flow Diagram
ER	Entity-Relationship
IT	Information Technology
JS	JavaScript
OS	Operating System
SQL	Structured Query Language
UI	User Interface
UX	User Experience

1 INTRODUCTION

1.1 Introduction

LabXplorer revolutionizes science education by providing an innovative virtual laboratory platform designed to transcend traditional learning methods. Tailored specifically for students and educators in STEM fields, LabXplorer aims to bridge gaps in practical science education by offering interactive simulations and experiments across diverse disciplines. This cutting-edge platform serves as a dedicated arena where learners can engage deeply with scientific concepts, conduct virtual experiments, visualize data, and collaborate seamlessly within their academic community.

1.2 Problem Statement

There are many general educational platforms available, but none are specifically designed to provide virtual laboratory experiences for science education. This means that students and educators often have to rely on traditional methods, which can be less effective for interactive learning and experimentation. Most general educational platforms do not have dedicated spaces for conducting virtual experiments. This makes it difficult for students to gain hands-on experience and apply theoretical knowledge in a practical setting. There are no specific tools available for creating and managing virtual lab simulations tailored to various scientific disciplines. This means that educators often have to use general-purpose simulation tools, which can be less effective for specific educational needs.

There is no specific platform that integrates various scientific disciplines into one comprehensive virtual laboratory environment. This means that students often have to use multiple platforms for different subjects, which can be cumbersome and disjointed. The lack of dedicated virtual lab platforms can make it difficult for students to engage deeply with the subject matter and for educators to track and assess practical skills development. These challenges can be even more pronounced for schools and institutions with limited access to physical laboratory resources, as they may not be able to provide adequate hands-on experiences for students.

1.3 Objectives

- Create a virtual laboratory platform that enhances science education through interactive simulations and experiments across various disciplines.

1.4 Scope

- The platform should provide a virtual space for students and educators to conduct interactive simulations and experiments across various scientific disciplines.
- LabXplorer should facilitate collaborative learning through discussion forums enabling students to share insights and ask questions.
- The platform should be user-friendly and accessible, making it easy for students of all levels to engage in virtual laboratory activities.

1.5 Report Organisation

The material in this project report is organised into seven chapters. After this introductory chapter introduces the problem topic this research tries to address, chapter 2 contains the literature review of vital and relevant publications, pointing toward a notable research gap. Chapter 3 describes the methodology for the implementation of this project. Chapter 4 provides an overview of what has been accomplished. Chapter 5 contains some crucial discussions on the used model and methods. Chapter 6 mentions pathways for future research direction for the same problem or in the same domain. Chapter 7 concludes the project shortly, mentioning the accomplishment and comparing it with the main objectives.

2 BACKGROUND AND LITERATURE REVIEW

2.1 Background Study

We are looking for designs that make out system visually appealing and at the same time have better performance. As this system is mainly for creatives who can share their journey, we need to implement a profile system that shows off their portfolio and resume. Showcasing their skills should be easy so this system mainly focuses on functionalities implementations. We are looking for different tools and techniques for achieving those goals. We are also studying papers, articles, and related books for our project. We are also learning about implementation about messaging system. The proposed project is to create an app for creative it professionals where they can share their discussions, projects, skills, and perform messaging functions. To develop this app, it is important to understand code collaboration, tools for code sharing, and messaging functions.

2.2 Limitation

- Graphics are planned to designed by myself can reduce in quality and become time consuming.
- We cannot message through our system directly.

2.3 Literature Review

Social networks are like groups of people who know each other and interact with each other. The technology helps us study how people are connected to each other and how they talk to each other online. It also helps us understand the things they say and the information they share.[1]

In today's competitive job market, organizations strive to identify and attract top talent, and this research investigates the influence of social media on the recruitment process. With the rapid growth of social media usage, it is crucial for organizations to understand effective strategies for attracting the best candidates. The study involved 12 recruiters from various industries, and the findings reveal heavy reliance

on platforms like LinkedIn for recruitment purposes. However, the use of Twitter and Facebook for recruitment is comparatively lower. Recruiters need a focused approach when utilizing social media to manage the potential overwhelming volume of work. It is evident that recruiters cannot effectively conduct recruitment activities without leveraging social media tools, but proper training in optimizing social media usage is essential. This study contributes to highlighting the significant impact of LinkedIn on recruitment processes, while also emphasizing that social media is not a one-size-fits-all solution for recruitment challenges.[2]

In Stack Overflow, A complete profile includes details such as a website URL, location, about me section, profile image, and age. Our analysis revealed that most users do not have a complete profile. However, users with complete profiles tend to have higher reputation scores and provide better quality question and answer posts compared to users with incomplete profiles. This suggests that having a complete profile is beneficial for contributing effectively to the network. Among the profile elements we examined, location and about me have a stronger relationship with user activity and contribution. This research helps us understand which profile elements are important in a Q and A social network and which ones should be prioritized for users to fill out regularly.[3]

We examine the characteristics of developers involved in Open Source software creation to understand what factors contribute to innovation within the Open Source community. The analysis reveals that having a higher reputation within the community increases the likelihood of attracting collaborators, although developers are also motivated by reciprocity, aligning with the principles of a gift economy. Additionally, we find a significant network effect resulting from standardization, indicating that developers who use popular programming languages in their projects are more likely to collaborate with others. Furthermore, providing additional information, such as a valid URL to the developer's homepage, increases the chances of finding coworkers. These findings can be applied to the broader population of experienced users on

platforms like GitHub.[4]

GitHub has recently introduced a new feature called Discussions, which serves as a platform for developers to ask questions and engage in broader discussions that go beyond specific Issues. Before its widespread availability in December 2020, Discussions underwent testing on selected open source software projects. In order to gain insights into developers' utilization of this innovative feature, their perceptions of it, and its impact on the software development process, we conducted a comprehensive mixed-methods study involving early adopters of GitHub discussions between January and July 2020.Developers perceive GitHub Discussions as a valuable tool; however, they encounter challenges related to topic duplication between Discussions and Issues. This issue poses a concern, as it leads to confusion and redundancy in communication.[5]

3 METHODOLOGY

3.1 System Development Approach

An incremental approach, also known as an iterative or step-by-step approach, is a development or problem-solving method that breaks down a larger task or project into smaller, manageable increments or steps. Rather than attempting to tackle the entire task at once, an incremental approach focuses on making incremental progress by completing and delivering smaller portions of work in a series of iterations.

- Initial Planning and Requirements Gathering
- Increment Planning and Design
- Development and Implementation
- Testing and Quality Assurance
- Evaluation and Feedback
- Iterative Development and Refinement
- Deployment and Release
- Repeat the Process for Subsequent Increments

3.2 Requirement Analysis

3.3 Feasibility Analysis

A feasibility study is a systematic and structured analysis conducted to determine the viability and practicality of a proposed project plan. It serves as an evaluation tool to assess whether the project can be successfully implemented and if it aligns with the organization's goals and objectives. It involves gathering and analyzing relevant information to determine if the project is technically feasible, operationally feasible, economically feasible, and scheduling feasible.

3.3.1 Economical Feasibility

Since the proposed system has a web application, we will be using free and open-source software development tools such as Flutter, Express, Postgres SQL. We will

only need some economy for server for hosting.

3.3.2 Operational Feasibility

LabXplorer emphasizes operational feasibility through its user-centric approach, focusing on intuitive design and ease of use. The system is crafted to be highly interactive, allowing users, including students and educators, to navigate effortlessly without requiring extensive mobile app expertise. The user interface (UI) is designed with a clean layout and intuitive controls, ensuring a seamless experience for exploring features such as virtual experiments and educational resources. By minimizing training requirements and reducing potential user resistance, LabXplorer aims to enhance user acceptance and engagement. Overall, its intuitive design facilitates efficient utilization of the app's functionalities, supporting educational activities and fostering a positive user experience

3.3.3 Technical Feasibility

Combining Express.js with Flutter and PostgreSQL presents a technically feasible approach for developing a modern and scalable application. Express.js, built on Node.js, serves as a powerful backend framework ideal for creating RESTful APIs and managing server-side logic efficiently. PostgreSQL, known for its reliability and advanced features in data management, provides a robust foundation for storing and querying data securely. On the frontend, Flutter offers a unified framework for building responsive and visually appealing applications across multiple platforms using a single codebase. This combination leverages the strengths of each technology: Express.js for backend scalability and API development, PostgreSQL for robust data handling, and Flutter for seamless cross-platform UI development. Supported by active communities and extensive documentation, this stack ensures technical support, resources, and flexibility for deployment and maintenance, making it well-suited for delivering modern, interactive applications.

3.4 HIGH LEVEL DESIGN OF SYSTEM

3.4.1 Architecture Design

The following diagram shows diagram of our Architecture. Mainly shows what are the functions can be accessed after starting our application.

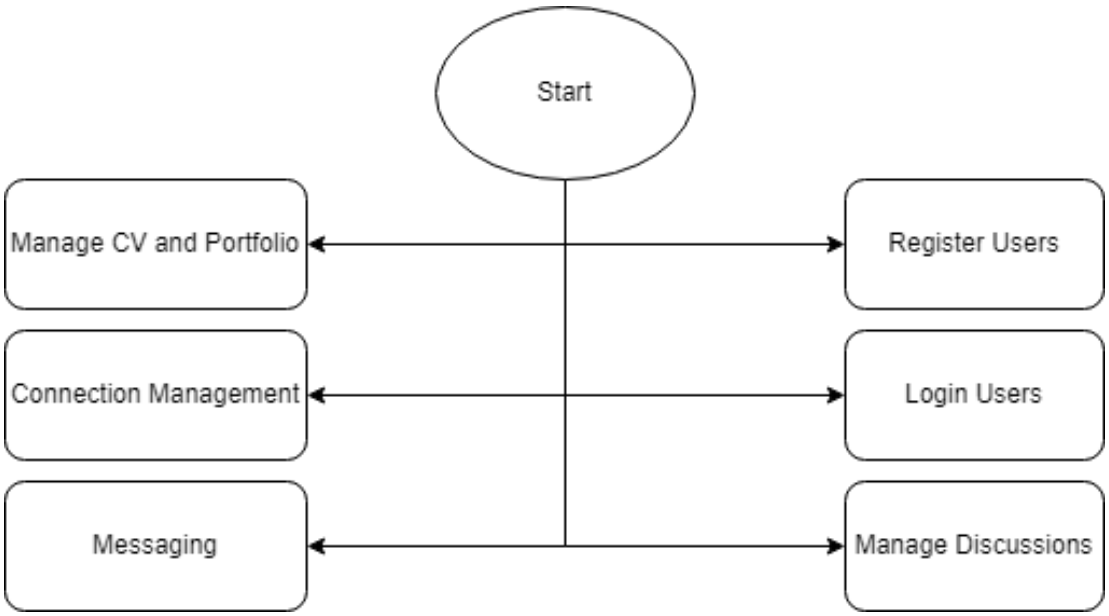

Figure 3.1: Main Architecture of System

3.4.2 Data Modelling(ER-Diagram)

ER Diagram is mainly used to design database schema. With the help of below er diagram we can easily design database in SQL.

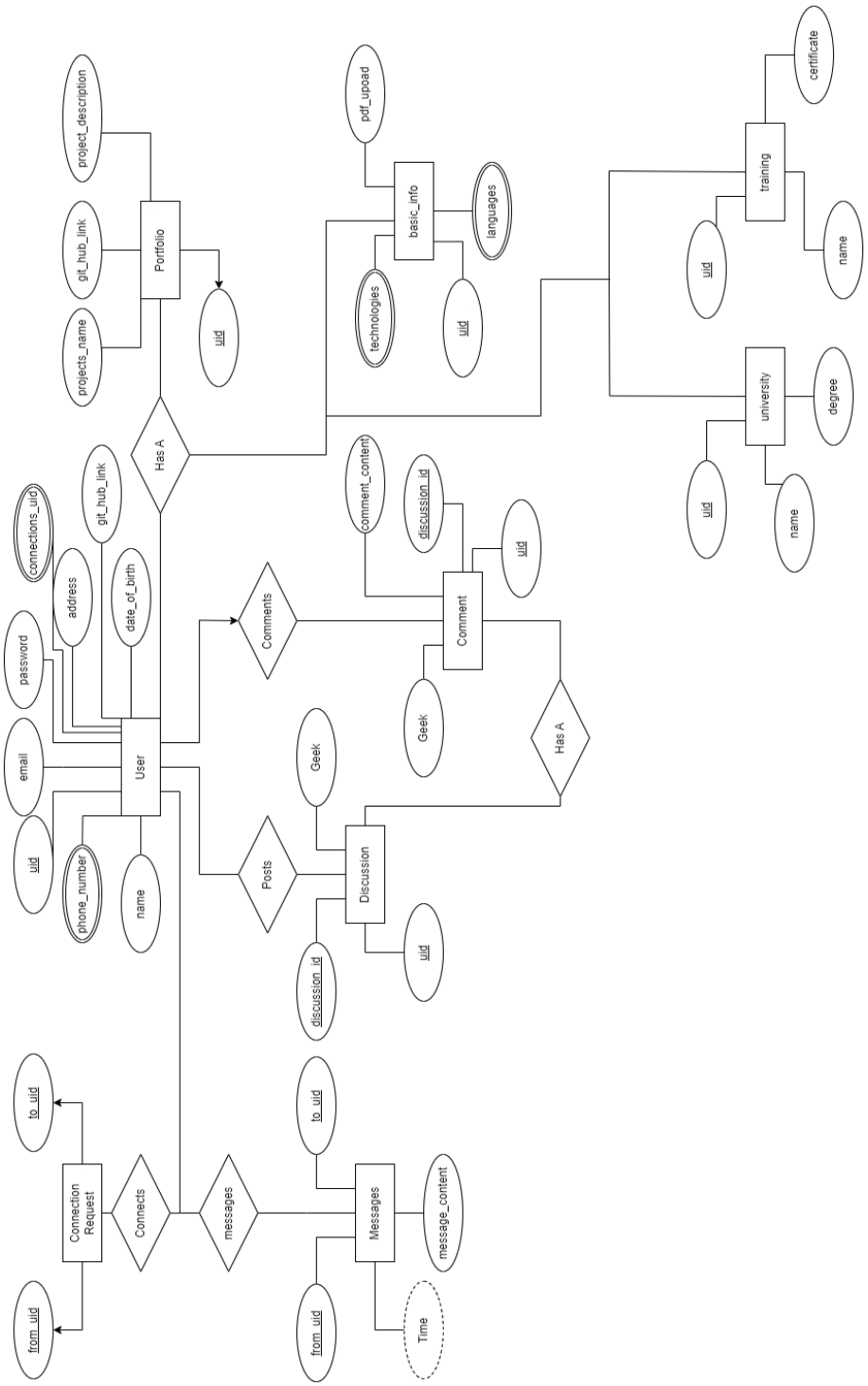

Figure 3.2: ER Diagram of System Data

3.4.3 Activity Diagram

An activity diagram visually presents a series of actions or flow of control in a system similar to a flowchart or a data flow diagram. This diagram showed how our program flow goes on.

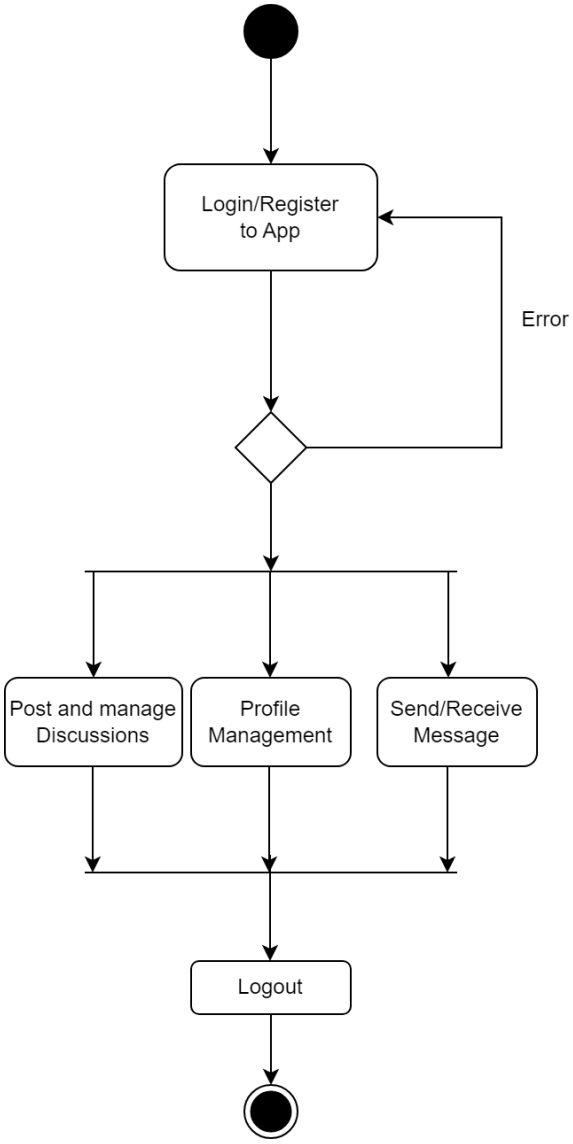

Figure 3.3: Activity Diagram

3.4.4 DFD

DFD or Data Flow Diagram is mainly used to show how data are being flowed in and out of our system. There are 3 levels of DFD i.e Context Level(Level 0),Level 1 and Level 2

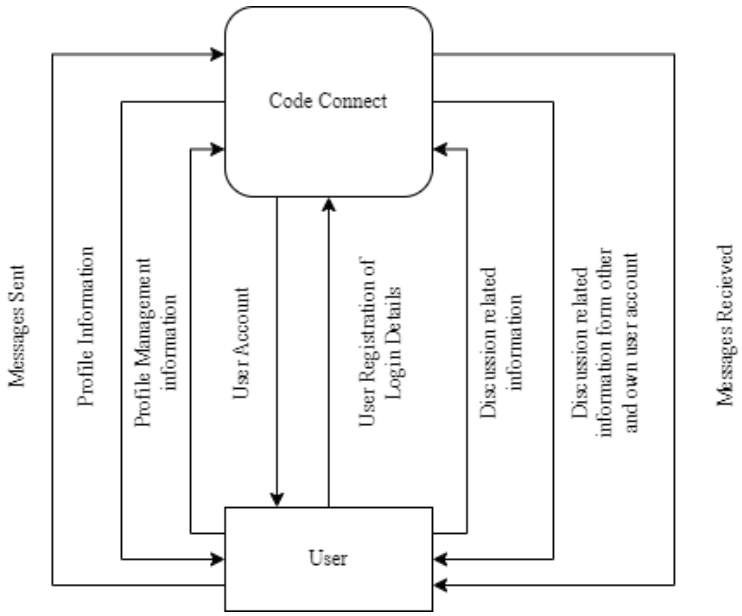

Figure 3.4: Data Flow Diagram (Context Level)

4 IMPLEMENTATION

4.1 Tools Used

Figma

Figma is a cloud-based design and prototyping tool that empowers teams to collaborate on UI/UX design projects in real-time. It offers a user-friendly interface and powerful features that make it a popular choice among designers. With Figma, designers can create and share interactive prototypes, design components, and design systems. Its cloud-based nature allows for seamless collaboration, enabling multiple team members to work on the same design simultaneously. Figma supports version control, ensuring that design iterations can be easily tracked and managed.

Flutter

Flutter is a versatile and innovative UI toolkit developed by Google, designed for building natively compiled applications across mobile, web, and desktop platforms from a single codebase. Utilizing the Dart programming language, Flutter enables developers to create high-performance applications with expressive and flexible UI components. Its reactive framework and extensive widget library facilitate rapid development and customization, allowing for visually rich and responsive user interfaces. Flutter's hot reload feature accelerates iterative development cycles by instantly reflecting code changes, enhancing productivity. With a growing community, robust documentation, and support for diverse plugins and packages, Flutter empowers developers to deliver seamless user experiences and streamline app development across various devices and operating systems.

Postgres

PostgreSQL, often referred to simply as Postgres, is a powerful open-source relational database management system known for its reliability, robustness, and extensibility. Developed over decades and maintained by a global community of contributors, PostgreSQL offers a comprehensive set of features for managing structured data. It supports complex queries, transactions with ACID (Atomicity, Consistency, Isolation, Durability) properties, and a wide range of data types including JSON, XML, and spatial data. PostgreSQL's commitment to standards compliance and continu-

ous improvement ensures compatibility with various programming languages and frameworks. With capabilities for scalability, data integrity, and advanced indexing, PostgreSQL is a preferred choice for applications requiring robust data management and high availability, contributing to its widespread adoption across industries from small startups to large enterprises.

Git/Github

Git is a distributed version control system that is both free and open-source, designed to handle projects of all sizes efficiently and swiftly. It simplifies collaboration by enabling multiple individuals to contribute changes that can be seamlessly merged into a single source. When using Git, the software runs locally on your computer, storing your files and their complete history. Alternatively, you can utilize online hosts like GitHub to store a copy of your files and their revision history. This central repository allows you to easily upload your changes and download updates from other developers, promoting seamless collaboration. Git facilitates automatic merging of changes, allowing multiple individuals to work on different sections of the same file and later merge their modifications without losing any work.

Node Js with Express

Node.js with Express.js is a powerful combination for building scalable and efficient web applications. Node.js provides a runtime environment that allows JavaScript to be executed server-side, leveraging its event-driven, non-blocking I/O model to handle multiple concurrent connections efficiently. Express.js, as a minimalist web framework for Node.js, simplifies the creation of APIs and routes, offering robust features such as middleware support, routing, and template engines. Together, Node.js and Express.js enable rapid development of RESTful APIs and web servers, making them well-suited for creating real-time applications, microservices, and back-end systems. With a vibrant ecosystem of libraries and active community support, Node.js with Express.js remains a popular choice for developers seeking flexibility, performance, and scalability in web application development.

JavaScript

JavaScript is a client-side scripting language that is used to create interactive web pages. It is a powerful and versatile language that can be used to do a wide variety of things, including adding animation and interactivity to web pages, validating form data, processing user input, making Ajax requests to the server, and creating games and other interactive applications.

Dart

Dart is a modern, object-oriented programming language developed by Google, primarily used with the Flutter framework for building cross-platform mobile, web, and desktop applications. Known for its simplicity, Dart combines features from various programming paradigms such as functional and reactive programming. It emphasizes developer productivity with features like strong typing, asynchronous programming with async/await syntax, and a rich standard library. Dart's ahead-of-time (AOT) compilation to native code and just-in-time (JIT) compilation for development mode contribute to its performance optimization. With its clear syntax, sound type system, and emphasis on building scalable applications, Dart facilitates rapid development and maintainability, making it a robust choice for Flutter developers aiming to create high-performance, visually appealing applications across different platforms.

5 CONCLUSION AND EXPECTED OUTCOMES

5.1 Conclusion

LabXplorer is an innovative virtual laboratory platform tailored for enhancing science education through interactive simulations and experiments. It aims to revolutionize how students and educators engage with scientific concepts by offering a diverse range of features. LabXplorer facilitates seamless exploration, collaboration, and learning across various scientific disciplines. This platform empowers users to conduct experiments, share insights, and leverage sophisticated algorithms to deepen their understanding. Additionally, LabXplorer integrates advanced reporting capabilities and decision-making tools, enriching the educational experience beyond traditional classroom settings.

5.2 Expected Outcome

LabXplorer aims to provide a transformative experience for students and educators in the realm of science education, addressing the challenges faced by newcomers and enthusiasts in navigating complex scientific concepts. By leveraging interactive simulations and experiments, LabXplorer offers an immersive platform where users can engage deeply with various scientific disciplines. It empowers students to conduct virtual experiments, explore theoretical concepts, and apply sophisticated algorithms, thereby enhancing their understanding and practical skills. LabXplorer also fosters collaborative learning environments where users can share insights, discuss findings, and collaborate on projects. Through this platform, newcomers gain valuable exposure to real-world applications of scientific principles and methodologies, bridging the gap between theoretical knowledge and practical implementation. By facilitating hands-on learning and access to comprehensive resources, LabXplorer endeavors to inspire curiosity, foster innovation, and prepare the next generation of scientists and researchers.

APPENDIX A

A.1 Project Schedule

Below is the Gantt chart of our project Schedule. We have planned to perfrom these specific tasks between these time frames.

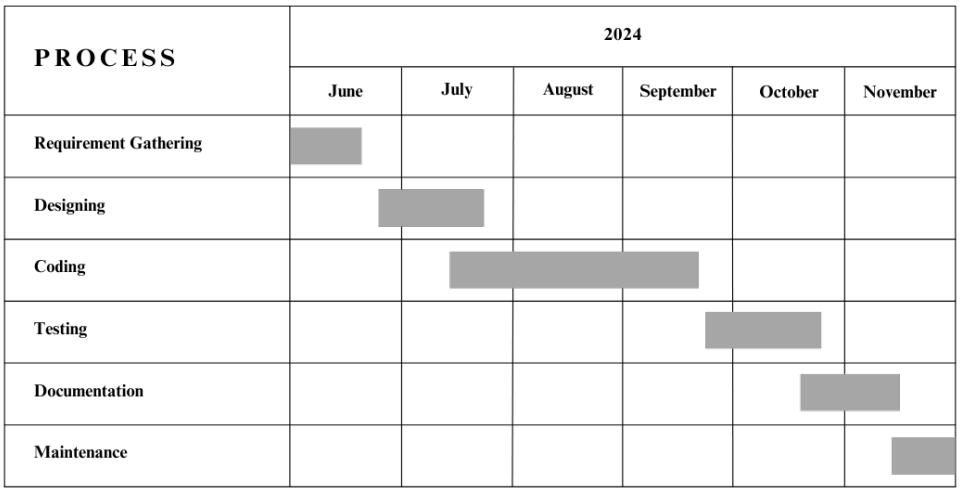

Figure A.1: Gantt Chart of Schedule

REFERENCES

[1] Anton Korshunov, Ivan Beloborodov, Nazar Buzun, Valeriy Avanesov, Roman Pastukhov, Kyrylo Chykhradze, Ilya Kozlov, Andrey Gomzin, Ivan Andrianov, Andrey Sysoev, et al. Social network analysis: methods and applications. *Proceedings of the Institute for System Programming of the RAS (Proceedings of ISP RAS)*, 26(1):439–456, 2014.

[2] Tanja Koch, Charlene Gerber, and Jeremias J De Klerk. The impact of social media on recruitment: Are you linkedin? *SA Journal of Human Resource Management*, 16(1):1–14, 2018.

[3] Ifeoma Adaji and Julita Vassileva. Towards understanding user participation in stack overflow using profile data. In *Social Informatics: 8th International Conference, SocInfo 2016, Bellevue, WA, USA, November 11-14, 2016, Proceedings, Part II 8*, pages 3–13. Springer, 2016.

[4] Dorota Celińska. Coding together in a social network: collaboration among github users. In *Proceedings of the 9th international conference on social media and society*, pages 31–40, 2018.

[5] Hideaki Hata, Nicole Novielli, Sebastian Baltes, Raula Gaikovina Kula, and Christoph Treude. Github discussions: An exploratory study of early adoption. *Empirical Software Engineering*, 27:1–32, 2022.