A Minor Project Proposal Report on

ELabX

Submitted in Partial Fulfillment of the Requirements for

The Degree of **Bachelor of Engineering in Computer Engineering**

Under Pokhara University

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Table of contents

1. Introduction

The proposed project is a lab management system that aims to improve the quality of lab classes in the context of programming. It will feature a digital course management system with topics and practice questions related to each subject offered by an institute. More importantly, the online code editor and the compiler will provide a platform to edit and run code and also check the results. Students must enroll in a course and work on practice questions in chronological order. This way, it becomes easier for teachers to grade and track the progress of a student in a certain course.

This project promotes collaboration and coordination among teachers and students. A digital course platform like this makes traditional hand-written lab reports and assignments obsolete. It also encourages students to work diligently and teachers grade each student sincerely. All offered courses and content are organized neatly and may be updated easily.

When a project like this is developed on a large scale, it works as a platform for learning and practicing programming in various languages. Individuals that are not affiliated with any college or educational institute can practice coding in a systematic manner as well as per their own schedule.

We will develop the ELabX with the software engineering concept at heart, following an incremental software development model. Each increment will add an additional working feature and the complete system is expected to be finished in 5 increments. We will be paying great attention to the initial research and design phases. As for programming languages and tools, we will be using HTML, CSS, ReactJS, and Figma for the front end; Python, Django, REST API, and Rust for the back end and MySQL for database management. Additional tools are version control systems(git) and Github for effective teamwork and documentation and Docker for containerization.

2. Problem statement

- The syllabus for the laboratory is not completed.
- Inadequate Interactive Learning.
- Outdated teaching-learning method.
- Lack of Community and Support.
- There is no system in place to monitor or keep records of students' progress
- Lack of progress tracking hinders the evaluation of student performance, understanding, and practical skills.
- Students lack the necessary instructions or materials for engaging in laboratory activities.

3. Project objective

- To develop a system that helps to keep track of students' laboratory progress.
- To develop a system that provides users with a sandboxed environment where they can run and compile the code relative to the course they enrolled in.

4. Scope

- Students don't need to be physically present in the college for their lab work as they can easily complete their work from home.
- This product can be easily expanded as a college or school course management system.
- It will help in progress tracking and grading for students.

5. Literature review

5.1 Sakai LMS

The Sakai Project began as a $6.8 million community source software development project started as a partnership between four universities: Indiana University, the University of Michigan, Stanford University, and the University of Massachusetts Institute of Technology, and two well-established higher education projects in the uPortal activity and Open Knowledge Initiative (OKI). The purpose of the project was to produce open-source collaboration and Learning Environment (CLE) software by integrating and synchronizing their many educational software into a pre-integrated collection of open-source tools[1,2].

The project was first released in March 2005 using Java programming language. The system of the Sakai project can also be considered a Learning Management System (LMS), Course Management System(CMS), or Virtual Learning Environment(VLE). This open-source education software platform was designed to support Enterprise services-based portals, a complete course management system with sophisticated assessment tools, a research support collaboration system, a workflow engine, and a tool portability profile. The Sakai LMS can be downloaded and used freely from sakailms.org. After registration, it gives a beautiful dashboard where a user can edit/set up his/her profile, read and add the contents, add a group, and create a research project and a course. Hundreds of institutions use Sakai as their primary LMS, mainly in the USA but also in Canada, Europe, Asia, Africa, and Australia. Sakai provides the flexibility of customization, third-party software integration, resource sharing, online discussion, etc., and hence supports improving teaching quality[1,2].

The Sakai LMS can be useful for every subject as a general LMS, but in the case of programming subjects like C++, Data Structure and Algorithm(DSA), it fails to provide such a sandboxing environment where a user can write, compile and submit their code for evaluation.

5.2 Rust Playground

Rust playground is a sandboxed environment that allows users to experiment with Rust code. In the Rust playground a React frontend communicates with an Axum backend and docker containers are used to provide the various compilers and tools to run and execute the program. It also provides modern IDE features like syntax highlighting [4].

However, our project aims to provide a sandboxed environment relative to the course a student gets enrolled in. Along with the code editing environment, it also provides details /hints about the particular problem a student is trying to solve in the course.

5.3 W3school

Similarly, there is a website called W3school that provides tutorials, examples, and references for various technologies with an online editor that enables users to experiment with code samples and view the outcomes in real-time. W3Schools also has a community forum where users may post queries, share information, and get help from other developers. A vast number of web technologies are also covered by W3Schools, including HTML, CSS, JavaScript, jQuery, PHP, SQL, and others.

Although W3Schools is a valuable resource for anyone interested in learning web development, some developers criticize it for being too simplistic and not covering some advanced topics. Additionally, it doesn't effectively monitor student achievement, and neither does it provide support for students or an assessment of their development or any certificates.

Shortcoming these limitations, our product ‘ELabX’ stays up-to-date on the latest trends and best practices by following blogs, Books, and news sources. As we collaborate with teachers and colleges/universities there LMS effectively monitors student achievement, provides support for students, and assists them by reviewing their work up to date.

5.4 Programiz

Programiz is an online platform for learning and practicing programming. It offers various tutorials covering topics such as Python, C, Java, DSA, JavaScript, C#, and mobile and web development. The content management system used by the developers to neatly organize all courses is Drupal.

One of the key features of Programiz is its interactive online code editor, which allows users to write and run code directly in their web browser, which was made possible using Docker and Kubernetes. Their mobile app “Learn Python” was developed using Flutter.

Although no official information is given, it is likely that the team used an iterative and incremental development approach. It involves breaking down a project into smaller, more manageable parts and completing each part through a series of iterations. It also allows for testing and feedback to be incorporated throughout the development process.

6. Methodology

Software Development Life Cycle(SDLC) provides a method for building and delivering software projects. There are various stages of SDLC such as communication, planning, design, implementation, and deployment. There are various software development models like waterfall, incremental, spiral, and prototyping, which are based on the framework provided by SDLC. Each model has their usage and criteria. We found an Incremental model also known as Rapid Application Development(RAD) is best suited for our project. This model combines elements of the waterfall model applied in an iterative fashion [3].

In our project there will be five increments, each increment will traverse through the stages of SDLC. Our end product is somehow clear but there are many requirements/features that we have to add or modify over time. In each increment, we will develop a working product and add new features to it. The incremental model provides such flexibility for software development, and the functionality in increments of our product will be something like this:

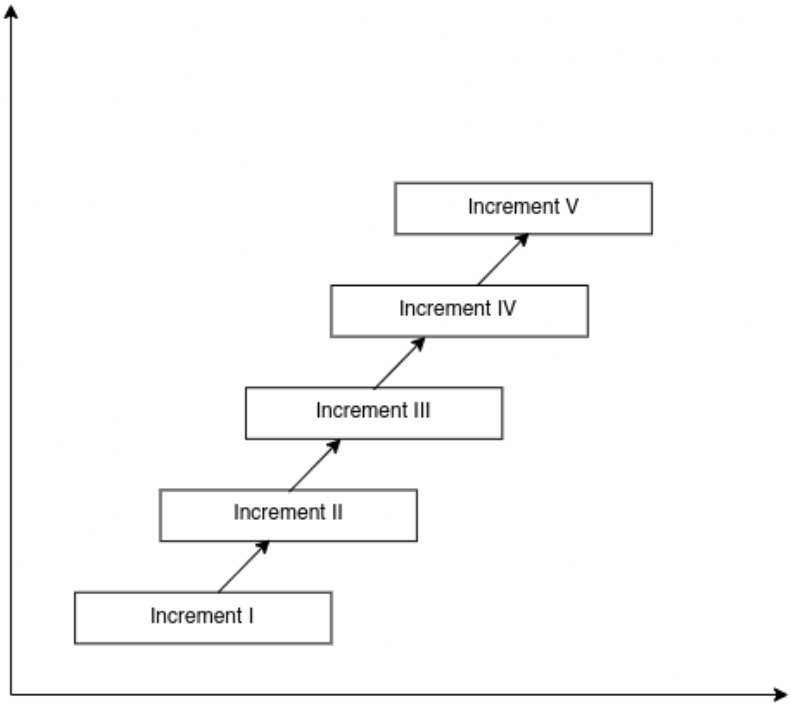

Figure 1. Incremental software development model

6.1 Increment I

- Create an environment for writing source code as a solution to a question
- Create API for compiling and running that solution
- Display the output and error of that code to the user
- Appropriate UI for that functionality

6.2 Increment II

- Develop database integration for the course
- Add a course eg C++, and contents for that course
- A way for adding questions to the database thru the web
- Appropriate UI

6.3 Increment III

- Student authentication
- Admin authentication
- Frontend for login and registration

6.4 Increment IV

- Integration of auto-grading
- Tracking the progress of the student
- Authentication of Teacher
- Review the submitted solution by the teacher

6.5 Increment V

- Extend for more courses
- Implement containerization
- Self-enrollment
- Improving the product by adding more increments, if needed

7. System flowchart

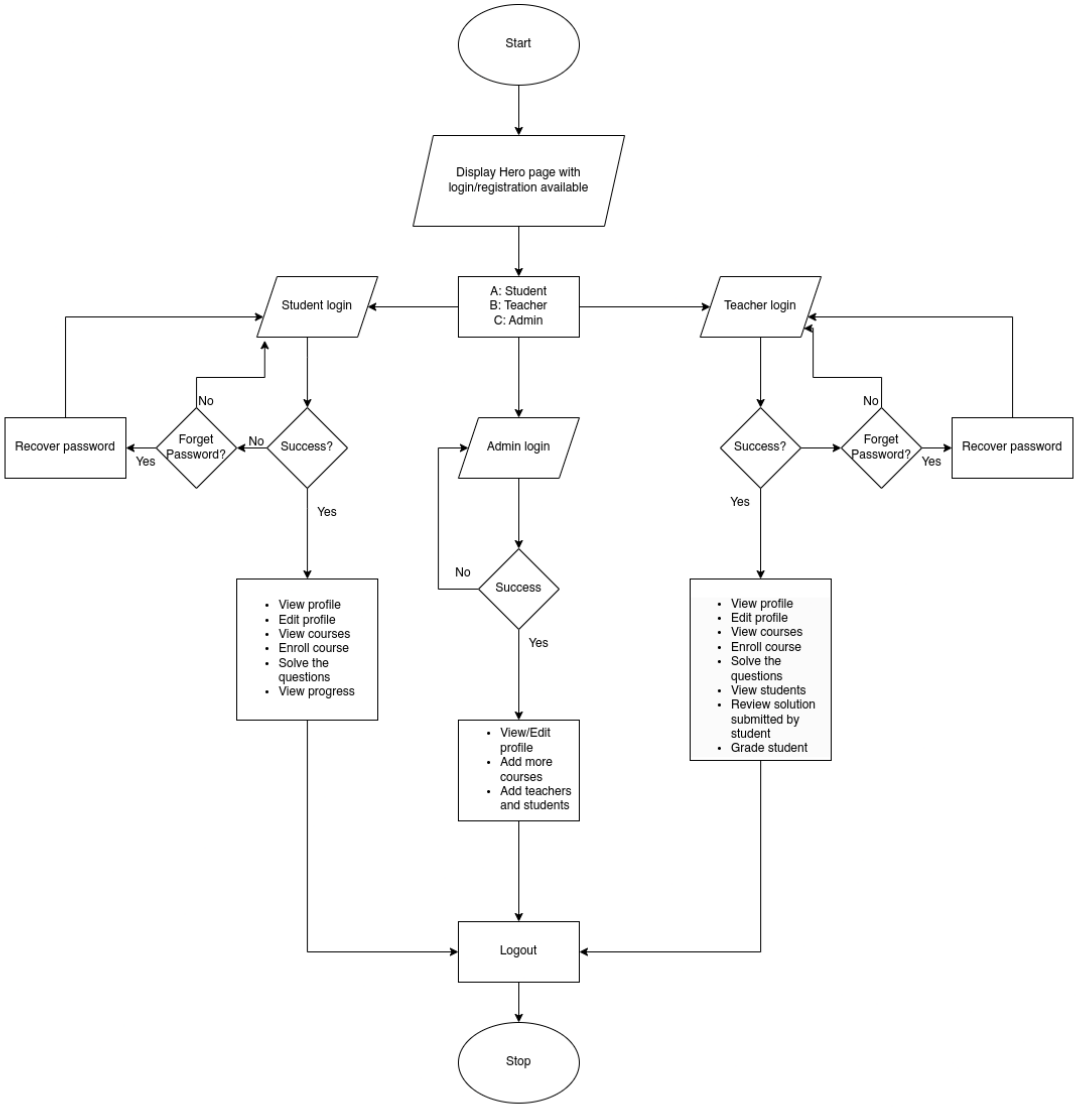

Figure 2. System flowchart for ELabX

9. Gantt chart

Figure: gantt chart

10. Expected outcomes

ELabX will be an online platform that will digitalize the lab system by providing a centralized platform for managing and delivering digital learning resources and tools. In the educational sector, the implementation of a lab management system (LMS) can bring about a range of expected outcomes, including:

- Increased flexibility and accessibility of course content
- Centralization of learning resources
- Online tests and grading
- Improved learning outcomes
- Improved teacher efficiency and effectiveness

11. Conclusions

Lab Management System would provide high-quality educational content, resources, and real-time compiler tools to help individuals learn and improve their skills in web development. The platform will offer a vast array of tutorials, references, and examples with the sandboxing environment for experimenting with codes in subjects like C, C++, DSA, Computer Graphics, DBMS etc.

It provides teachers and students with a centralized platform for creating, delivering, and assessing courses, which makes it simpler for them to manage their teaching resources, monitor student progress, and assess learning outcomes.

12. References

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