VIRTUAL LABORATORY FOR JAVA

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ABSTRACT-Experimenting in a computer science course is difficult owing to limitations in space, equipment, and unique experiment tools. In this paper, we design two types of virtual lab platforms and develop corresponding virtual lab systems for computer science curricula courses based on an analysis of the experimental features of computer science curricula such as the Principle of Computer Organization, Digital Image Process, Digital Signal Process, and so on. Every experiment instrument in the real lab is displayed as a Java component in the first virtual lab. The algorithm students learn in the course is packaged as a Web Service component in C, C++, or Java in the other type of virtual lab. Such components are listed in the system in both platforms. Students can choose Java components or Web Service components based on the needs of the experiment and combine them by connecting them. The students can then enter input for the experiment into the input component. The result will be presented for the students on the platform when they click the rum button. Students can also develop code on the platform in the two types of virtual laboratories. Upon submission, the platform will transfer those programmes as a component and add them to the component list. After that, users may utilise them as platform components. As a result, students can verify whether the algorithm they create is right. The Java Virtual Lab is an interactive online environment designed to provide a hands-on learning experience for Java programming language. It allows students to practice and experiment with Java programming concepts and techniques without the need for a physical lab setup. The virtual lab provides a range of features including a code editor, compiler, debugger, and a virtual machine to run Java programs. It also offers a variety of programming challenges and exercises to test the knowledge and skills of the students. The Java Virtual Lab is a valuable tool for students learning Java programming as it allows them to explore, experiment and learn in a safe, controlled and interactive environment.

I.   PROBLEM STATEMENT

Our future education system purely depends on online educational platforms. As we experienced learning difficulties during the pandemic situation through online teaching platforms, which only provide interaction between the teacher and the students. And most of them started to follow the concept of self-with learning. But there is no way to experiment with problems in which the absence of a laboratory, which is provided in educational institutions. Since most of them cannot afford additional paid courses. Computer engineering studies are most has on practical knowledge rather than theoretical knowledge. We are trying to overcome such difficulties through a

virtual laboratory that can be accessed by anyone in any part of the world.

II.   PROPOSED SOLUTION

Our solution to overcome the problem is by creating a virtual lab(vlab) that offers the following features:

✔ Concepts of java is explained clearly in a theory format along with examples.

✔ Provides a step-by-step algorithmic explanation of the concepts in java along with the program.

✔ A java simulator is provided for practice, which helps the user to enhance their self-learning.

✔ Our website is a user-friendly environment which can be accessed either through a mobile or desktop.

✔ In addition to this a test section is also provided to evaluate their learning skills which could be helpful for their self-learning purpose.

✔ Instructor also can design their experimental test on this platform.

✔ Message section is provided in order of communication.

III.   BENEFITS OF PROPOSED SYSTEM

Java Virtual Lab (JVL) is a software tool that provides a simulated environment for users to learn and practice programming concepts using the Java programming language. Some of the benefits of using a Java Virtual Lab include:

- ☐   Cost-effective: A Java Virtual Lab eliminates the need for expensive hardware and software, making it a cost-effective solution for both individuals and organizations.

- ☐   Flexibility: Users can access the virtual lab from anywhere, at any time, using just an internet connection and a web browser. This allows for greater flexibility and convenience, particularly for remote learning or collaboration. Hands-on experience:

- ☐   The virtual lab provides a safe and controlled environment for users to practice coding without the risk of damaging their own equipment.

- ☐   This allows for more hands-on experience and experimentation, which is crucial for developing programming skills. Instant feedback: The virtual lab provides instant feedback on code execution, allowing users to quickly identify and correct errors in their code.

☐ Collaborative learning: The virtual lab can be accessed by multiple users simultaneously, allowing for collaborative learning and real-time feedback and support from peers or instructors.

☐ Real-world scenarios: The virtual lab can simulate real-world scenarios, allowing users to apply their programming skills to practical problems and scenarios. Overall, a Java Virtual Lab is a valuable tool for both beginners and experienced programmers, providing a safe, flexible, and cost- effective way to learn and practice Java programming.

IV.INTRODUCTION

Java Virtual Lab is a software application that provides a simulated environment for learning and practicing programming concepts using the Java programming language. It is a tool that allows users to develop programming skills in a safe, controlled, and flexible environment. With JVL, users can access a simulated computer system that runs Java programs, without the need for expensive hardware or software. This allows for greater accessibility and convenience, particularly for remote learning or collaboration. One of the key benefits of JVL is that it provides a hands-on learning experience, allowing users to practice coding without the risk of damaging their own equipment. It provides instant feedback on code execution, which allows users to quickly identify and correct errors in their code. Additionally, JVL is a cost- effective solution for both individuals and organizations, as it eliminates the need for expensive hardware and software. Another advantage of JVL is its flexibility. Users can access the virtual lab from anywhere, at any time, using just an internet connection and a web browser. This allows for greater convenience and flexibility, particularly for remote learning or collaboration. JVL also supports collaborative learning, allowing multiple users to access the virtual lab simultaneously, and providing real-time feedback and support from peers or instructors. In summary, Java Virtual Lab is a valuable tool for both beginners and experienced programmers, providing a safe, flexible, and cost-effective way to learn and practice Java programming. Its hands-on learning experience, instant feedback, and flexibility make it an effective tool for developing programming skills and applying them to real-world scenarios.

V. LITERATURE SURVEY

The current system is a manual one. As a result, all information about the student, courses, and staff is kept in the file. Professors have separate files for students and information, attendance, and a separate file for reports, among other things. Students have multiple notes for each course, and they occasionally forget things during lectures. This Virtual Classroom is a system that is accessible at any time, day or night. While lab application in student learning is highly significant in scientific education. It has several limitations and issues, especially in underdeveloped nations. Because India is also a developing country, it confronts the same challenges problem. The following are some of the major issues encountered: Laboratory operations are costly in terms of carrying out experiments and setting up equipment. It takes significantly more time to plan and apply. In packed courses, it might be difficult to monitor students' performance during activities. A lack of lab or equipment, or improper lab settings, inhibits the teacher's ability to complete a simple lab exercise. Furthermore, they overcome the

potential threats that might be experienced in real-world situations (Yenitepe, 2001). For example, a risky experiment for human health is created in a computer as a simulation so that students may examine the experiment design, run the experiment in a computer, and view the results. Simulations provide benefits over undertaking risky, difficult, or impossible tests in terms of time, security, expense, and motivation. We now utilise a manual system, so the file contains information on student courses and faculty. For faculty, there are distinct files for each purpose, such as a file for student information, attendance, and reports. For students, there are multiple notebooks for different topics. Sometimes they forget things during lectures, but we have unlimited access to the virtual classroom system and may utilise it whenever we want. Although the 24 hour scientific education lab application has an impact on student learning, it has several limitations and issues, particularly in underdeveloped nations. India is also a developing country, so it faces the same challenges. Laboratory activities are expensive, particularly in terms of carrying out experiments and acquiring equipment; the process takes a long time; and checking students' performance during activities can be difficult in over-crowded classes with insufficient lab equipment or insufficient conditions that prevent a teacher from performing a simple laboratory activity. Experiments for real-time calculations, for example, can be simulated in computers so that students can observe how the experiments are designed and performed in computers. Instead of performing dangerous, difficult, or impossible experiments, simulations have advantages in terms of time, security, and motivation.

ADVANTAGES:
- ✔ Our website creates an interface for students using self-evaluating.
- ✔ A simulator is provided to deliver step-by-step algorithmic explanations for good understanding.
- ✔ Basic quiz is provided to improve their logical ability.
- ✔ It is a different self-learning interface that provides a better idea of implementation.
- ✔ It is user-friendly, as anyone can access this lab from anywhere.
- ✔ Contact support is provided to service the need of users.
- ✔ Overall concepts are provided in the format of detailed ones both theory and programming part.
- ✔ The experiments in it can be repeated again and again, so students who communicate mostly online will not be afraid of real-life situations.

DISADVANTAGES
✔ To access the virtual lab, you must have an internet-enabled device and a basic understanding of how computers work.
✔ Online laboratories can reduce the interaction between students and faculty.

VI.   EXISTING SYSTEM

There are some existing systems available on the internet that can be accessed via the internet. There is a virtual lab that is an initiative of the national mission on education through ICT its goal is to provide access to simulation labs in various fields of science and technology as well as to yield a learning structure centred on the online labs where students can use the provided study tools such as learning- resources animated explanations videos and self- evaluation. It only provides with stimulation area and not any evaluations to test the acquired knowledge.

A.   Virtual Operating System Laboratory (VOSLab)

☐   The Swiss Virtual Campus (SVC) Operating System Laboratory (OSLab) project is an online course that will teach the student about the basics of computer operating systems using a progressive approach and problem-based learning.

☐   OSLab focuses on providing the student with a hands-on training experience.

B.   Virtual Mathematics Laboratory (VMathLab)

☐   Virtual Math Lab is a collection of apps intended to aid in the teaching and study of precise sciences. It began as a tool for boosting learning efficiency and making it more appealing to pupils, assisting them in understanding mathematical concepts and their applications.

VII.   METHODOLOGIES:

A.   Front-end:

●   Hypertext Markup Language

●   Cascading Style Sheets

●   JavaScript

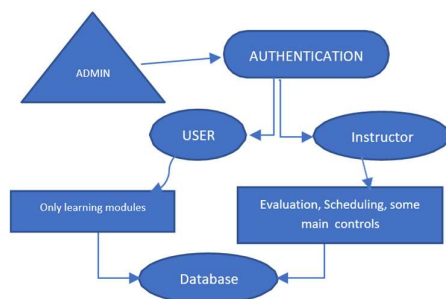●   Bootstrap

B.   Back-end:

●   NodeJS/PHP

C.   Tools:

●   Visual Studio Code

●   IIS

D.   Database

●   My SQL

VIII.   FLOW DIAGRAM

IX.   WORK FLOW

The workflow of the webpage is to create a practice area, where the students can work out their programs, and a test area in which the tests are conducted for the faculties to evaluate the students and grade them accordingly. There will be a stimulation area that provides the students with a certain number of programs, with which the students can understand the working of the programs understandably. The learning is not only taught by the teachers, students can also do the learning with the resources that are provided on the website that are revised and written by experienced persons. The analytics part gives detailed feedback to the student about their programming skills, the part where they have to improve. The instructor login contains all the necessary operations that are required for an instructor. They can schedule a test, evaluate a test, and can send messages to the dashboard of the student page. The learning resource and the program stimulations can only be accessed or changed by the admin only.

X.   MODULES

Modules are the contents in the webpage that leads to many other features in that page. The following are the functionalities in student login of our website:

A.   STUDENT LOGIN

[1]   AUTHENTICATION:

The basic signup page is created that consists of separate requirement data. This module has two way of authentication methods which means different accounts can be created for instructors and students. The instructor account consists of some special features that are not present in the student's account. Student account consists of some self-learning modules alone. For the purpose of authentication, the data like mail IDs and passwords are used. At the initial stage of account creation, all the personal data are collected for identification purposes. First name, last name, mail id, password, contact details, profile picture, Type of user, their college details Are some of the most commonly required data for the purpose of account creation.

[2]   DASHBOARD:

- It's a simple tool in the navigation bar that displays the overall specification of this webpage.
- When a click is done the other modules are displayed.
- A search option is also created to find the required module which reduces the time of searching.

[3]   PRACTICE AREA:

- It consists of a compiler platform that can be used to execute our practice programs.
- It accepts both user-defined and predefined Inputs.
- It consists of the programs that we had practised to the current.
- The saved program can be accessed again when required.
- Compiler that is bonded with this practice area consists of several required packages that are required for mid-level operations.

[4]   MESSAGES:

- Messages module acts as a communication module between the instructor and the user.
- User can clarify their doubts with the help of these messages.

☐ It is a two-way communication system that can communicate endlessly in an efficient manner.

☐ Communication with friends also is possible with the help of this message module.

[5] ANALYTICS:

☐ It is a kind of self-analysis.

☐ Simple quiz is provided in between the modules and they are evaluated with the help of predefined answers.

☐ The rankings of the user and their level of learning is displayed in this module.

☐ It contains the overall percentage and the individual score.

☐ It also consists of the corrected answers for the wrongly answered questions.

[6] Exam:

☐ This section is used to perform the experimental tests provided by the instructor a faculty.

☐ It displays the time limit.

☐ Quiz type of test can also be provided.

☐ If the practical test is provided, the It is same as the practice area and the action done can be viewed by the faculty or instructor.
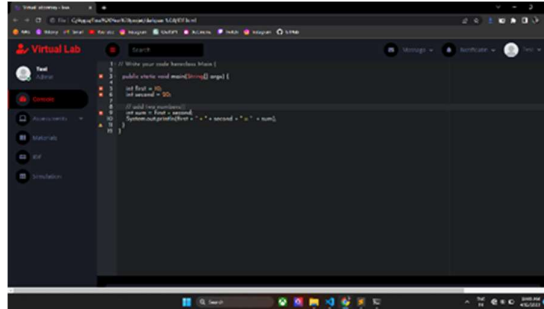
[7] Learning resources:
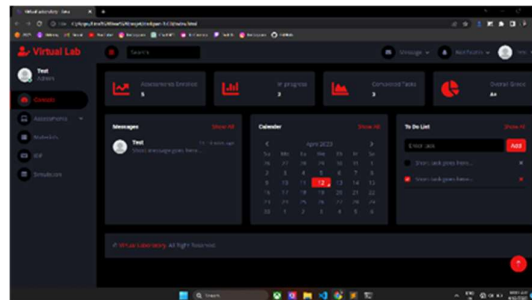
\- Landing page
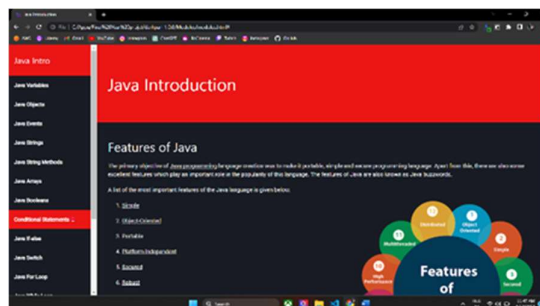
\- Learning resource

\-   Practice area

B.   INSTRUCTOR LOGIN

The instructor account has some extra modules that are not available in the student account. This account has access nearly equal to the admin. They can access the overall page without any restriction.

a)   TEST:

✔   In this module user can design the practical test for the students.

✔   They can provide the questions either in an image format or a text format.

✔   They can also set a time limit according to their need.

✔   Shuffle option is also provided to randomly allocate the questions.

b)   EVALUATION:

✔ In this window the test response can be viewed.

✔ The actions of a student performed in the test window can also be viewed on this page.

✔ Two types of the evaluation process is provided in terms of manual and automatic.

✔ Manual correction is done for everyone by faculty when they prefer manual the l option.

✔ Automatic correction is done with the help of provided answer key when the automatic option is selected.

✔ The results can be sent to the student's windows once the evaluation is done.

X.   SUMMARY OF THE SURVEY:

✔ The Autumn 2007 survey enabled a categorization of the materials based on the relevance indicated by the students. The results demonstrate that all resources were given good ratings, indicating that the recommended resources were acceptable for a VLab. [1] (Raghu Raman, Krishnashree Achuthan, Vinith Kumar Nair, Prema Nedungadi)

✔ A preliminary examination of the survey findings reveals that all of the VLab materials are quite relevant. Between 65% and 81% of students thought they were significant or necessary resources. [2] (Shweta Soni, M.D.Katkar)

✔ Aside from that, the survey findings allow resources to be divided into three categories depending on their relevance: human factors, pedagogical factors, and technical aspects. This categorization demonstrates that, while technology considerations are "enabling tools" for a VLab, students place a higher value on personal and pedagogical components.[3] (Michael G. Xevgenis, Lazaros Toumanidis)

XI.   CONCLUSION

To summarise, Java Virtual Lab (JVL) is a great tool for both novice and professional programmers, offering a secure, flexible, and cost-effective approach to learn and practise Java programming. JVL enables users to practise programming in a virtual environment without the need for specific gear or software. It offers hands-on learning, quick feedback on code execution, and the ability to replicate real-world circumstances, making it a powerful tool for acquiring programming abilities and applying them to real-world challenges. Because of JVL's flexibility and accessibility, it is a great tool for remote learning or collaboration, since users may access the virtual lab from anywhere, at any time, with only an internet connection and a web browser. JVL's capacity to facilitate collaborative learning and give real-time feedback and help from peers or instructors boosts its efficacy as a learning tool even further. Overall, JVL is a wonderful choice for everyone interested in learning Java programming, from beginners to seasoned programmers. It is a useful tool for personal and professional growth because it provides a secure, regulated, and cost-efficient environment for learning and practising programming skills.

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