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Cloud Based OTG Lab for Computer Programming Languages

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ABSTRACT: Practical work is one of the most important instructional tools in education. The practical training of students' skills is a relevant dimension of the overall education process, especially in the case of educational courses that fall into the Science, Technology, Engineering, and Mathematics category. To address concerns linked to the cost and space requirements of traditional hands-on laboratories, technology-enabled laboratory modes, such as virtual, remote, and take-home laboratory modes are proposed. In this project, we propose ``OTG Lab'' as a framework for leveraging digital twins and extended reality technologies to streamline the development and operation of hands-on, virtual, and remote laboratories. The OTG Computer Labs are virtually-hosted labs allowing access to lab software, the network drive (N-Drive), and access to a Windows operating system, all on a powerful system capable of handling intensive workloads and processing. Educational OTG labs are real computer science laboratories that can be controlled over the Internet through a computer, mobile device, or tablet, without installing anything. These types of labs enable faculty and students to access equipment and/or computers via the internet to perform experiments and laboratory tasks without being in the physical lab space.

KEYWORDS: Cloud-based OTG lab, Virtual programming lab, Programming languages, Cloud computing, Web-based compiler, Remote access, Lab management, Scheduling administration, Automatic grading, Learning platform

I. INTRODUCTION

In computer science, programming courses such as Java, C, Python, C++, the computer science (CS) lab plays the most significant role in helping freshmen students to learn the coding for the first time. Hands-on technology-exploration experience for students is an integral part of the traditional Computer Science Curriculum. In the labs, students work on some programming assignment problems and submit them on an online platform to be graded by instructors. The labs are designed to get students hands-on coding and implement the programs on the computer. Basic programming skills are not only necessary for Computer Science majors but are an important skill just as basic Math, Physics and Chemistry for students in all majors. As such Universities are making introductory programming courses as required in all the curriculums. Writing programs and executing them to see the program's output is as necessary as doing physics or chemistry experiments. Universities have recognized the importance of practical lab component for a computer programming course and so most of the courses are accompanied by a separate lab hour. However, in many situations, these labs become just a place for students to write programs and submit for grading. Due to the failure to deliver laboratory courses, the growth of distance-learning programs are also limited to certain disciplines. The inclusion of STEM disciplines for distance-learning is slowed down due to the lack of provision for laboratory course offerings. Simulation and multimedia can facilitate a level of educational experience; however, for effective and meaningful education within the STEM disciplines, a combination of theoretical and laboratory sessions is essential. As it is now, distance-learning programs need their students to visit a designated campus for the laboratory part of the program and most of the time these are for a limited period of time.

II. EXISTING SYSTEM

Colleges and universities provide students with on-campus computer laboratories which they can use for coursework, research and other learning activities. These labs usually house dozens to thousands of computers equipped with software applications for different purposes. Eventually, campuses started building physical computer labs to grant that easy access to technology students. In college in house labs, we pose different programming activities, that require strong lecturer–student interaction. Instructors need a system to not only communicate with students, but also see the code they are typing. When a student makes an important mistake, or they are not doing what they should, the lecturer could be able to see it and help them out straightaway—that is how we do it in face-to-face labs.

Disadvantages

- Machine and equipment costs

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- Personnel costs for troubleshooting, maintenance and software installation
- Repair and upgrade costs
- Software licenses, antivirus protection and other core programs
- Real estate costs
- Students will need to come on campus to complete in-person learning requirements.

III. PROPOSED SYSTEM

A OTG computer lab is a learning platform hosted on the cloud and made accessible to its users via web browsers. The OTG Lab includes web-based compiler and remote access for programming, as well as lab management and scheduling administration tools. This technology gives students the ability to access software programs and work with them as if the applications were running on their own computers. OTG labs allow students to perform their coursework in a virtual learning environment anytime and anywhere, as long as they have a device connected to the Internet. It is used in modern engineering laboratories to help academic researchers and students perform laboratory programs remotely through the Internet. From the client side, a computer is connected to the internet with a Web browser from which the real experiment is to be conducted. On the server side, there are two important components: A lab server and a Web server. The lab server consists of a computer connected to the different compiler to compile the program.

Advantage

- Support and accommodate distance learning
- Allow learners to easily and quickly assess the educational resources they need
- Provide an efficient and cost-effective alternative for schools without the ability or means to build and maintain computer labs
- Maximise software licenses and reduce expenses
- Help develop digital skills and hone employability skills for all students, including those who prefer to learn remotely or flexibly.
- Effective distance learning

IV. SYSTEM OVERVIEW

Learning institutions need to invest in computers, servers, printers, scanners, projectors and internet modems or wireless routers when building physical computer labs. On top of that, they also need to consider the costs of building a room which will house all the equipment along with furniture such as desks and chairs. Finally, they also need to invest in proper ventilation, maintenance and power supply. Due the quantity of programs developed by the students and naturally the need to evaluate them a problem was found. With the current teaching model, with several assignments during the academic period, teachers spend a lot of time to evaluate all the programs and to grade. On the last year's teachers referred that they need to spend lots of time with this program evaluating process. With a big set of proposed exercises, it is not possible to evaluate all of them in a deep way, thus the solution is evaluated by sampling.

Module Description

1. OTG Lab Dashboard

The OTG Lab (VSL) is a web-based platform designed to improve learning approaches by introducing a safe and interactive computer science lab environment for students. online compiler and debugging tool which allows you to compile source code and execute it online in more than 10 programming languages. It is an online compiler and debugger tool for the most popular programming languages like C, C++, Python, Java, PHP, Ruby, Perl, etc.

2. Compiler Integration

Supports most widely used programming languages such as C, C++, Java, C#, Python, Ruby, PHP, Objective-C, Go, Scala, NodeJS, Clojure, Perl, VB.Net, MySQL, Bash. In computer science, syntax analysis is an important phase in the process of compiling a program. It involves checking the source code of a program to ensure that it follows the correct syntax of the programming language in which it is written.

3. Code Editor

In this module Student enter the source code for assigned program. It is an online IDE tailored for OTG development to implement a text input field with support for many editing features, and has a rich programming interface to allow further extension. It uses Web Containers. A full parser package, often with language-specific integration and extension code, exists for the following languages: CSS, C++, HTML, Java, JavaScript, JSON, PHP, Python. It has lot of features like syntax highlighting, live code auto completion, code snippets etc., it also has features like creating and managing files, with given file system, managing multiple files with open file tabs system.

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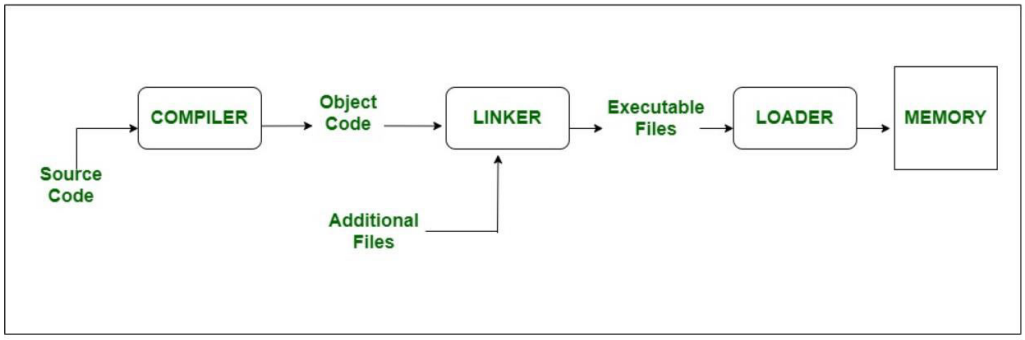
4. Program Loader

Instant and accurate code evaluation. Unlike manual checking, automated code analysis and grading provides accurate feedback to students. It is one of the essential stages in the process of starting a program, as it places programs into memory and prepares them for execution. In the execution of the program, major role is played by two utility programs known as Linker and Loader.

4.1. Linker: A linker is special program that combines the object files, generated by compiler/assembler and other pieces of code to originate an executable file has .exe extension. In the object file, linker searches and append all libraries needed for execution of file. It regulates the memory space that will hold the code from each module. It also merges two or more separate object programs and establishes link among them. Generally, linkers are of two types:

1. Linkage Editor
2. Dynamic Linker

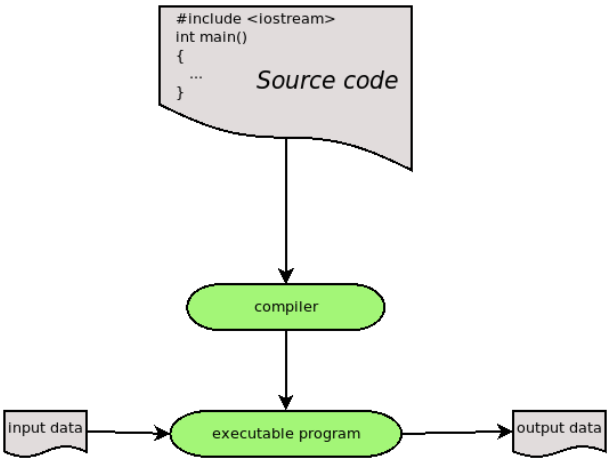


4.2. Loader: It is special program that takes input of executable files from linker, loads it to main memory, and prepares this code for execution by computer. Loader allocates memory space to program. Even it settles down symbolic reference between objects. It is in charge of loading programs and libraries in operating system. The embedded computer systems don't have loaders. In them, code is executed through ROM. There are following various loading schemes:

- Absolute Loaders
- Relocating Loaders
- Direct Linking Loaders
- Bootstrap Loaders

5. Program Compile and Execute

This module integrates the compiler and interpreter to run the program. A compiler is an executable program that takes program source code (text) as input and translates it into an executable program (binary machine code) that it writes into a file as output. That executable program can then be run to process input data and generate output according to whatever we wrote our program to do.



An interpreter is an executable program that takes program source code (text) as input, translates it internally to determine what computation it describes, then simulates the execution of that program to process input data and generate output according to whatever we wrote our program to do.

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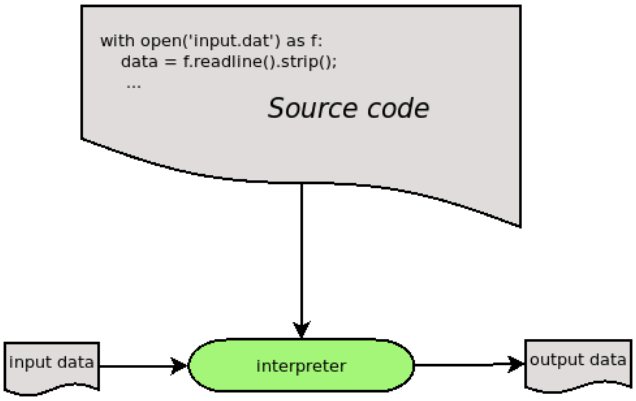
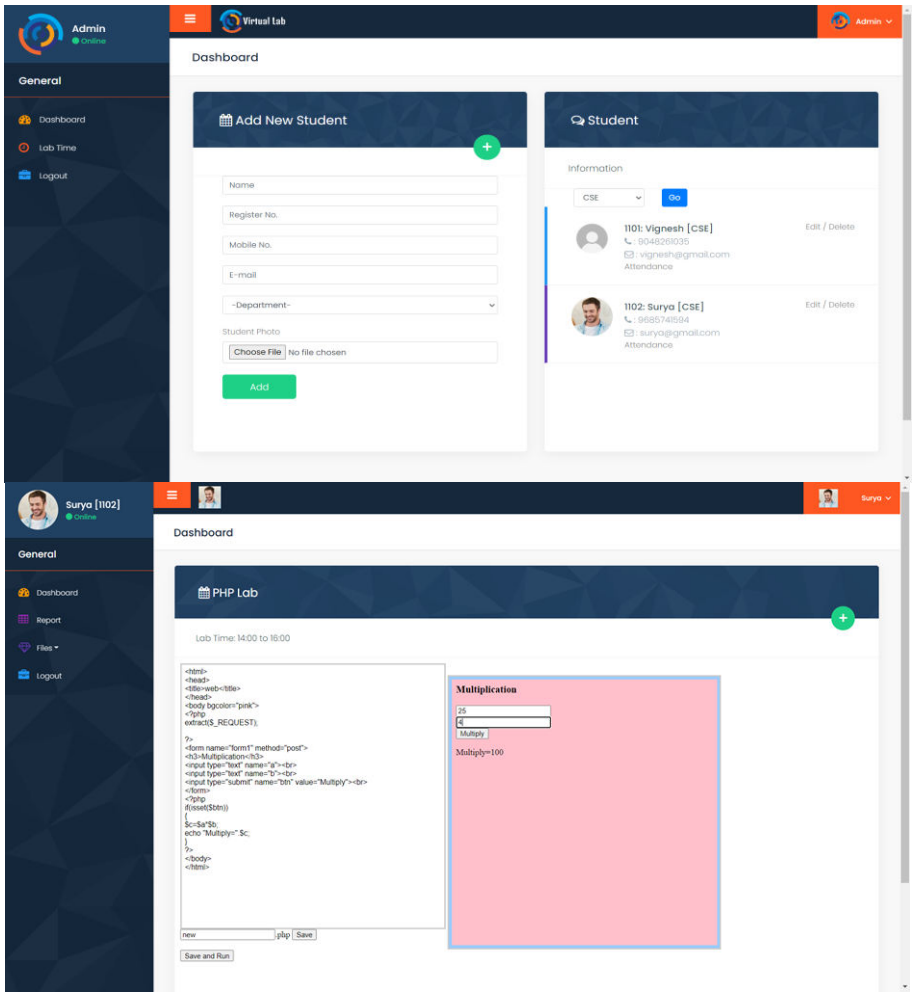


V. EXPERIMENTAL RESULTS



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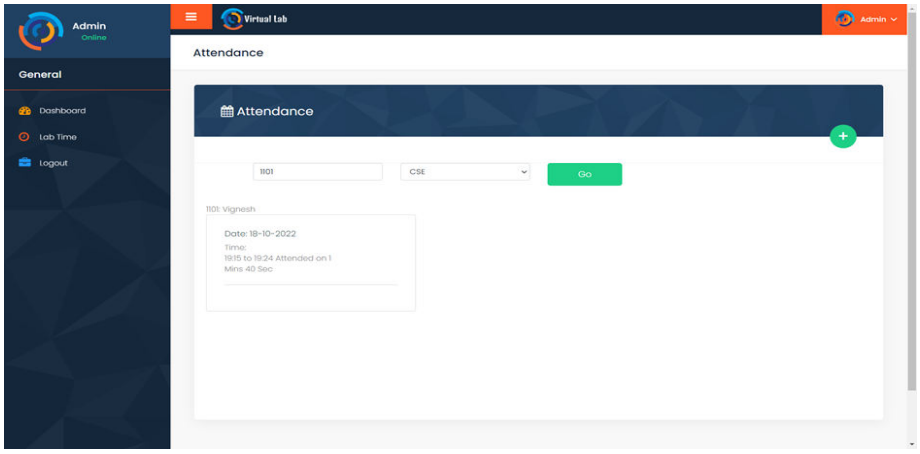

VI. CONCLUSION

OTG Lab is an online computer lab is a virtual platform that provides access to various computer applications, software, and tools. Such platforms can be accessed remotely and offer a variety of benefits to users. In conclusion, an online computer lab can be a valuable resource for students and professionals who need access to specialized software and hardware for learning or work. It can provide a convenient and flexible way to access computing resources without the need for physical infrastructure or expensive equipment. Developed OTG an online computer lab involves several steps, including selecting the right hardware and software, designing the lab environment, and implementing security measures to protect user data and prevent unauthorized access. One of the key advantages of an online computer lab is that it can provide users with access to expensive software and tools that they may not be able to afford otherwise. This can be particularly beneficial for students, researchers, and professionals who need access to specialized software for their work. Another advantage of online computer labs is that they can be accessed from anywhere with an internet connection. This makes it possible for users to work remotely, collaborate with others, and access their work from multiple devices. OTG, an online computer lab can be a useful tool for users who need access to specialized software or who need to work remotely. However, it's important to carefully evaluate the platform and its features to ensure that it meets your specific needs and requirements. Overall, an online computer lab can be a useful tool for education and work, providing users with the necessary resources to complete projects and achieve their goals.

VII. FUTURE ENHANCEMENT

The future of online computer labs looks promising, as more and more people are relying on digital technologies for education, work, and communication. Here are some potential developments in the future of online computer labs:

- **Artificial Intelligence:**

AI-based systems can help users of online computer labs to optimize their performance, track their progress, and provide personalized recommendations based on their learning or work style.

- **Virtual and Augmented Reality:**

Virtual and augmented reality technologies can be integrated into online computer labs to create immersive learning or work environments, where users can interact with digital objects and experience real-life scenarios.

- **Internet of Things (IoT):**

IoT devices can be integrated into online computer labs to provide real-time data and insights, such as user behaviour, environmental conditions, and device performance, which can be used to improve the quality and efficiency of the lab environment.

- **Blockchain Technology:**

Blockchain technology can be used to provide secure and transparent access to online computer labs, enabling users to verify their credentials, track their usage, and protect their data from unauthorized access or tampering. Overall, the future of online computer labs looks bright, with new technologies and innovations emerging to enhance the learning and working experience for users, making it more accessible, engaging, and effective.

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