V.C.L - Virtual Chemistry Lab

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Abstract - *This paper is to scale the entire chemistry laboratory to a single-window on the computer. The project idea is developed for Polytechnic college having the specified set of experiments in their syllabus. It is a web-based application designed to perform chemistry experiments. It has a login module to allow authorized students to perform the experiments. It aims at performing complex chemical reactions at the click of a button. The goal is not only to make chemistry more exciting but also to save huge expenses of equipment and chemical reagents. The cost as well as the time required to perform these experiments are reduced. A secondary purpose is to eradicate the need for maintenance of the laboratory. The design of this virtual lab is done in such a way that it is fully compatible with the diploma syllabus. The programming languages HTML, CSS is used for structuring and designing the website, PHP and MYSQL is used for compatibility and integration of the frontend to the backend, and JavaScript is used for an interactive response on the client-side.*

Key Words: Experiments, Simulation, Chemistry lab, JavaScript, MySQL, Web browser, Virtual lab.

1. INTRODUCTION

This web application helps to understand chemical experiments with the help of an interactive environment containing animations for a multiplicity of reactions and gives information about some molecules, making boring experiments look thrilling. The entire lab is constructed within the web browser of a computer or any smartphone. This environment has a close resemblance with the actual physical lab, at the same time giving a better picture of what actually happens in the chemistry lab. It works in a similar way as compared to the traditional chemistry laboratory. Traditional chemistry laboratories usually contain sophisticated electronic equipment and expensive apparatus, undergraduate students rarely have the opportunity to operate that equipment and usually are only told how it works or allowed to observe it being used by an instructor; this drawback is overcome in the developed web application. It is different from other experiment simulators as the creators have taken care of the existing knowledge of the diploma students, and have tailored the web application to ensure that the concepts are well-understood. For example, a guide bot that pops up whenever there is some kind of ambiguous situation while performing chemical experiments.

2. OBJECTIVE

This virtual chemistry laboratory would eradicate the need of visiting the Chemistry lab to perform an experiment and students would be able to perform the experiments independent of the place they are in, aiding to portability. The main objective of this project is to overcome the limitations of traditional chemistry laboratories and to enhance accessibility. The principle of this project can be used in pharmaceutical companies and chemical industries.

Example: Colleges, Universities.

3. TECHNOLOGY STACK

3.1 XAMPP

The creators used this tool to create a web server on the local network. The tool also provides phpMyAdmin software, which was used to create MYSQL databases.

3.2 Apache HTTP Server

This tool is used to process server-side code into static web-pages. In this project, it processes server-side code (PHP) to maintain the login sessions for the users.

3.3 MySQL

MySQL is a Relational Database Management System (RDBMS) and a variation of Structured Query Language (SQL) used to store databases used by the web application. It is used to store the information of components that are necessary to perform chemical experiments and the login credentials of the users.

3.4 HTML5

It is used to build the basic structure of a web application. It is used to create the layout of the environment like creating divisions e.g. Aim of the experiments, Selection of the experiments, and a dedicated pane for performing experiments.

3.5 CSS3

It is used to set the visual style of web pages. It is also used for aligning components and formatting texts. The CSS keyframe was used for animating the movements of the apparatus while performing chemical experiments, For example, the movement of droppers, test tubes, and beakers.

3.6 JavaScript

In this project, it was used to set the visibility of the components while performing chemical experiments based on certain user actions. JavaScript is also used for making web applications more engaging and interactive. For example, while adding a chemical into the test tube with a dropper the measurement level of the contents of the test tube increase.

3.7 PHP

PHP is used for establishing and maintaining connectivity between server-side and client-side of the web applications. In this project, it is used to manage dynamic contents, databases, and session tracking of the users for performing chemical experiments in the web application.

4. IMPLEMENTATION

4.1 Frontend

The front-end of the developed web-application uses HTML, CSS, and JavaScript. There are mainly three divisions on the web application, which are developed using HTML frameset and frame tag. The first division is the header frame required for displaying the Project title, which remains intact irrespective of the experiment being simulated. Secondly, there is a navigation division containing a drop-down for selecting the experiment to be simulated from the experiment list. Also, this division can be used to fluently switch between experiments if the need arises. The aim of the experiment being performed is also displayed in this division so that it becomes easier for the user to identify what exactly has to be done in that particular experiment. Lastly, the third division is a simulation area, where the experiment could be performed virtually. This area initially displays a welcome page, until an experiment is selected.
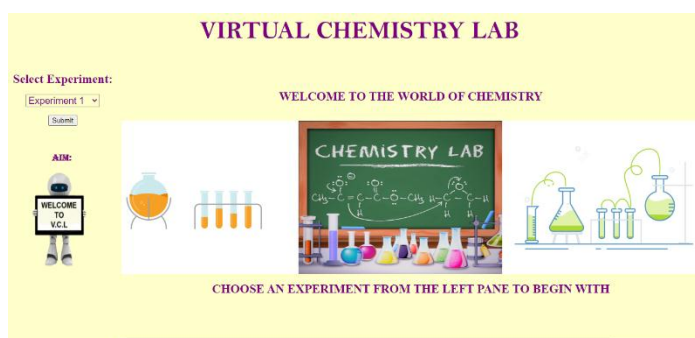

Fig -1: Home Page of VCL web application

4.2 Backend

The backend of the web application is implemented using PHP. A MySQL database containing the login details of students and administrators such as username, password, student ID, student-email are maintained in the server.

The PHP code helps users interact with the database with registration and login activities. The PHP session headers ensure that only logged-in users are able to access the simulation space and also aid in preserving the session when the page is refreshed or the user moves on to another experiment.

ID	Username	Email ID	Password
1505680050	Akshay	akshaygalgali@gmail.com	Akji@128
1505680051	Prem	prembhajaj@gmail.com	Piqdf@134
1505680052	Prithvi	prithvidunchu@gmail.com	Spisd@13
1505680053	Om	omraj@gmail.com	Likfd<144
1505680054	Jay	jaymehta@gmail.com	Jiksf@12
1505680055	Anita	anitasharma@gmail.com	Asdf@134
1505680056	Kamla	kamlashetty@gmail.com	Ksgrr<459

Fig -2: Database containing login credentials of dummy users

5. RESULTS

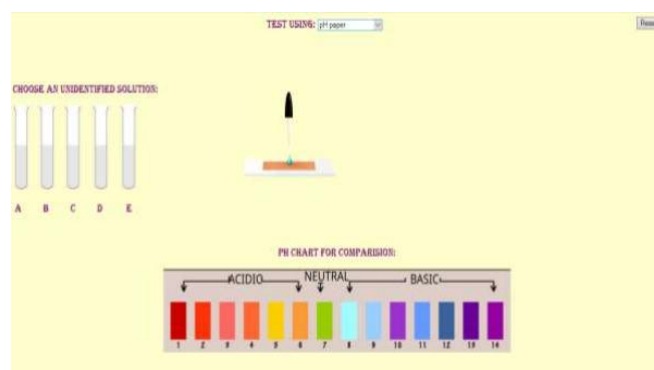Following are the snapshots of a few experiments simulated in the VCL web application.

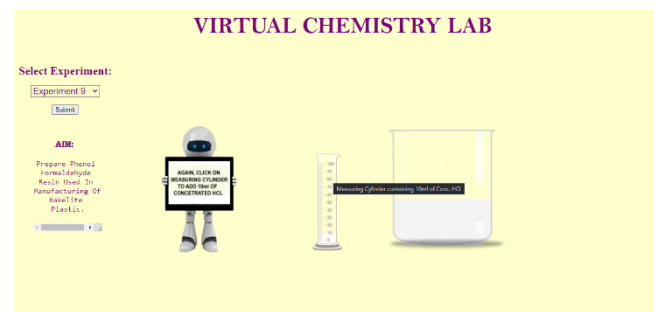**Fig -3**: Simulation of pH paper test

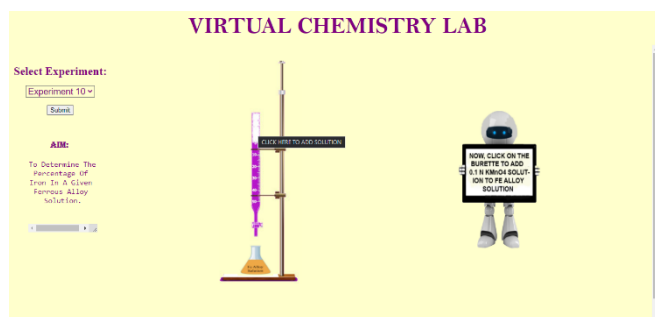**Fig -4**: Preparation of phenol formaldehyde resin

Fig -5: Determining the percentage of iron in a ferrous alloy solution

6. FUTURE SCOPE

The creators aim to provide the administrators an option to graphically create new experiments. Also, a new environment can be created for conducting practical examinations wherein all the apparatus and chemicals available in the virtual lab would be made available to the student, and the student has to select appropriate apparatus and correct quantities of chemicals to perform the allotted experiment. Another enhancement that can be added to the web application is a visual representation of the statistical report of the students' progress to the administrator.

7. CONCLUSION

The Virtual Chemistry Lab would help you to understand and prove your experiments through simulation. The VCL is an idea which depicts the efficiency and effectiveness of simulation of chemical experiments. This project conveys a vision of performing chemical experiments virtually which can be a robust alternative for traditional chemical laboratories in the future generations.

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