3D Virtual Lab using Multimedia Techniques forAdvancedLearning

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Abstract- **We can use the multimedia techniques for the advancement of education. As we know that virtual world provides a logical progression in learning tools within a constructivist pedagogical perspective. Gaming industry cannot only be used for entertainment but can also be used for education purposes. So we have developed a 3D virtual lab environment in which a user can simulate the various research experiments and can learn from a distant place.**

Keywords: **3D environment simulation, Virtual lab, multimedia techniques in e learning.**

I. INTRODUCTION

Physical distances and the lack of resources make us unable to perform experiments, especially when it involves sophisticated instrument.Good teachers are always a scarce resource. Web-based and video-based courses address the issue of teaching to some extent. With the present day internet and computer technologies, thelimitations can no more hamper students and researchers in enhancing their skills and knowledge. Rapid changes in the field of engineering technology have increased the need for universities to provide students with meaningful and relevant practical experiences.

There are many software available in market; some are freely available and some are commercially available that can be used for the development 3D environment and objects, and can easily be used for developing techniques or software to make education more flexible and more advanced. The Virtual lab simulates a list of various experiments (designed in 3D environment) so that the user feels that he/she is actually performing the experiments in the real world.To make Virtual Lab easy and useful, one can take advantages of various internet technologies so that a user can access all data online and perform the experiments at any place and at any time either online or offline according to his/her needs.3D Virtual lab is designed in such a way that a student, researchscholar or novice user can use the lab forlearning through computer.

II. SYSTEM OVERVIEW

For the implementation of 3D virtual lab, some experiments of UG level and as well as PG level of civil engineering background are selected. As the instruments used for civil engineering experiments are very expensive so this type of lab is very beneficial. We have designed a website (http://www.vlabcivil-iitr.co.in/index.php)where a user can login and access all the experiments. Website itself presents a unique way to describe each experiment or help the user. Figure 1 shows the website page view. Video lectures and study material related to each experimentisprovided on the website itself(Figure 2 shows the list of experiments available on the website). Initially we have included list of 10 experiments. User can download the executable file on his machine and run the file which presents the 3D environment (as seen in 3D games) in which user can move from one place to another along with the instruments and perform the necessary steps tocarry out the experiments.Files containing readings can be stored on the machine and can be used for further calculations.3D designing of the experiments and simulation is one of the challenging parts of designing virtual lab. Some experiments are also designed in 2D environment for the simplicity of the user.
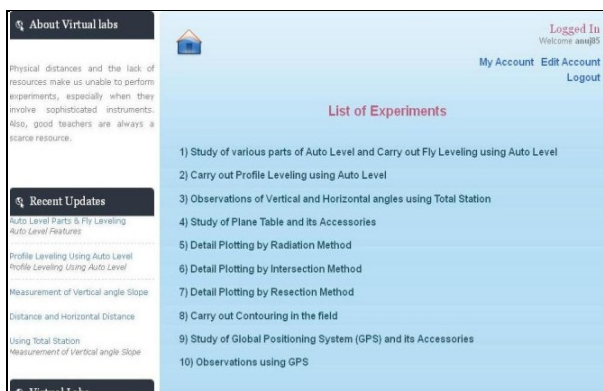
Fig. 1 Homepage of website

Fig. 2 List of Experiments

III. TOOLS FOR DEVELOPING VIRTUAL LAB

To make Virtual Lab very efficient, it is designed in 3 stages.Each phase is designed separately. Description of each phase is given below:

1. Website Development
2. 3D designing of experiment
3. 2D designing of experiment

1. *WEBSITE DEVELOPMENT*

To access all experiments, first the users have to register on the website, after registration users will log in. In registration process website needs arecord of userseducational qualificationasstudent or research scholar or novice user. Website has many other features, like feedback form for user, video lectures, website links for more study, picture gallery of various instruments and quiz. Audio feature is also included for the slide representation of the experiments for better understanding. Various technologies/software used are as follows-

1.XAMPP 1.7.3
2.PHP

3.MySQL
4.JavaScript
5.AJAX

2. *3D DESIGNING OF EXPERIMENT*

As designing of experiments in 3D environment is one of the major challenging tasks, so we have very precisely designed this part. Firstly, we prepare the 3D model of all instruments and then export them to other software for applying animation and simulation. Sound facility is also included in some 3D experiments (Fig. 3 shows 3D view of one such experiment- Study of GPS).For this process, we have used many software, that are listed below-

1. Autodesk 3ds Max 9 (for 3D model designing)
2.Quest 3D version 4.3.2 (for simulation)
3. Adobe Photoshop (for texturing)

Fig 3 shows 3D GPS in 3D environment

3. *2D DESIGNING OF EXPERIMENT*

Some experiments are designed in 2D environment for the simplicity of the user and to reduce the complexity of the experiment (Figure 4 shows 2D representation of one such experiment-Plotting ground details by Resection method). Softwareused for the 2D designing are as follows-

1. Adobe Flash CS5/Macromedia Flash 8
2. Adobe Photoshop CS5
3. Adobe Photoshop
Necessary help and steps at any stage in experiment are clearly displayed on the screen every time.

Fig. 4 shows 2D representation in Flash

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IV. MEHODOLOGY

Methodology is divided into 3 stages as discussed earlier. Different steps are carried out in each stage.

1.WEB DEVELOPMENT

To make Virtual Lab useful, we carried out many interactive steps for the website development. Accessing website is very easy and, there is no fee for accessingwebsite and performing operations online or offline. The steps involved in development of website are as follows-

1) Design user interface
2) Create login form
3) Create Registration
4) Embedding classroom video lecture and experiment videos in the website
5) Validate pages and user using java script and PHP
6) Report generation in PDF
7) Photo gallery and slideshow using PHP and Flash
8) Embedding 3D experiments in the website

2. 3D DESIGNING OF EXPERIMENT

To develop 3D Lab, the original instruments are needed only one time for image capturing and taking measurement of the various components or parts of the instrument.These measurements and images are used to make 3D model of that instrument (3D model of GPS is shown in fig. 5). Some texturing is also done at this stage. When these models are ready, they are exported in another 3D environment for animation, and finally they are rendered for use. Different lighting and cameras are also used to make the environment real.Steps to carry out the experiment in 3D environment are mentioned on the website. Steps for designing 3D model and 3D environment are given below-

1) Taking Images
2) Measurements
3) Making Sketches
4) Modeling Objects or Design 3D Objects
5) Texturing
6) Placing Cameras/Lighting
7) Animating Objects
8) Rendering
9) Creation of standalone application and web compatible file

Fig. 5Comparison between real GPS and 3D model of GPS

3. 2D DESIGNING OF EXPERIMENT

To reduce the complexity of experiments, some of these are designed in 2D environment using different software.Designing experiments in the 2D environment is also an important part of virtual lab. Different kinds of animations are used to make experiments more useful and more attractive. Virtual 2D environment designed gives the feeling of real 3D environment. Various steps of methodology are as follows-

1) Taking Images
2) Measurements
3) Making Sketches
4) Design 2D Objects
5) Texturing
6) Placing Objects
7) Applying various techniques for simulating or animatingobjects
8) Creation of standalone application and web compatible file

V. APPLICATIONS

Virtual lab contains a complete guide for a student user to perform the experiment. Video lectures, links for extra study material, etc. are provided on the website. Some applications in brief are given below-

1.3D virtual lab is very cost effective as instruments arerequired only once for imagecapturing.
2. No breakage or wear and tear of instruments.
3. Encourage E-learning among the students and act as helping guide for learning.
4.Useful in remote locations or areas toencourage education.
5. Many users can download the file simultaneously and perform the experiment offline also with no cost.

VI. CONCLUSION

Virtual lab is very useful to spread education in remote areas. We have designed virtual lab for civil engineering background similarly, virtual lab for other backgrounds can also be designed.3D view or 3D perception alsoenhances the learning capabilities of the user. Also, when good teachers are scarce,this kind of lab is very useful. Video lectures given by good institutes or organizations can be delivered to other students or users. Using other multimedia techniques or animation and withinnovative conceptswecan make education easier and more attractive.

ACKNOWLEDGEMENT

REFERENCES

1. Duggal, S.K. (2004). Surveying, volume 1. Tata McGraw-Hill Publishing Company Limited.
2. Charles D. and Wolf, Paul R. (2008). Elementary Surveying: An Introduction to Geomatics. Pearson Prentice Hall.
3.Arora, K.R. (2005). Surveying, volume 2.Standard Book House.
4. Davis, Raymond E. and Foote, Francis S. (1953). Surveying: Theory and Practice. 4th Ed. McGraw-Hill Book Company.
5. Punmia, B.C., Jain, Ashok K. and Jain, Arun K. (2005). Surveying volume I & II.16th Ed. Laxmi Publications.
6. Jie Zhang. (1999). Programming Technique of Interactive 3-Dimensional Graphics Based on Java 3D., Posts & Telecom Press.
7. Zhigeng Pan, Adrian David Cheok. (2006). Virtual reality and mixed reality for virtual learning environments, Computer & Graphics, Vol.30, pp.20-28.[CrossRef].
9.C.Bouras, A.Philopoulos, Th.Tsiatsos. (2001). e-Learning through distributed virtual environments.Journal of Network and Computer Application, Vol.24.
10. Yunhui Liu, Hiroshi Noborio and SuguruArumoto.(1988). Hierarchical Sphere Model (HSM) and Its Apllication for Checking an Interference Between Moving Robots.Proc.IEEE Int. Workshop Intelligence Robots and System.

Link:

1. Virtual lab for online and offline purpose:http://www.vlabcivil-iitr.co.in/index.php