International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 11 Issue 5 –NOVEMBER 2014.

Chemistry Learning and Practicing through Virtual Laboratory

Dr.D.Bala Karuna Kumar, and Dr.Y.Hanumantha Rao

Department of Chemistry, Andhra Loyola College, Vijayawada, A.P., India

Abstract— This paper describes implementation of information and communication technologies has developed different types of virtual laboratories, in this case is being developed a virtual laboratory which has a virtual world that allows the immersion in an environment conducive to practical implementation of distillation in chemistry field, along with an electronic device specifically a virtual reality glove that has the function to capture the movements and position of the student's hands, and thus making the practice very close to reality and generating a theoretical and practical learning.

Index Terms— chemistry, distillation; virtual laboratory; virtual reality

I. INTRODUCTION

Nowadays, there is an increasing popularity in virtual laboratory environment for its prominent advantages of intuition and interactivity between teaching and studying Interactive tools accompanied by modern educational theories configure a tool that currently has a very important impact in students of all areas of science and technology and has a main role in the current educational process.

The objective of the virtual laboratory proposed in this paper is to create a laboratory environment which motivates students to discover connections between theory, simulation, and physical systems through independent experimentation with up-to-date professional tools.

Today the implementation of educational tools in interactive environments has allowed the acquisition of knowledge, it presents an innovative and efficient way to learn and teach giving the opportunity for students to access experimentation in an almost real manner, allowing their full learning which is not dependent on specific artifacts and materials but on accessing to the virtual laboratory

The implementation of information and communication technologies has developed different types of virtual laboratories, in this case is being developed a virtual laboratory which has a virtual world that allows the immersion in an environment conducive to practical implementation of distillation in chemistry field, along with an electronic device specifically a virtual reality glove that has the function to capture the movements and position of the student's hands, and thus making the practice very close to reality and generating a theoretical and practical learning.

Although theoretical concepts are essential and need to be taught, it is very important to also show students how to apply the theory they have learnt in very different and important practical situations. [3] In some areas of knowledge the apprenticeship is not complete until you have developed different practical activities, so an example of this case is the chemistry field. Many subjects are based on it (practicing and experimenting), especially subjects which have more partialness, such as: programming, physics, chemistry, and other engineering subjects.

Besides, virtual laboratory can also benefit distance education and learning-on-the-job students, who maybe asynchronous in time or in space, even more, for the cost and time needed for traveling to a local lab would often prevent them from using such real laboratories. Moreover, the virtual laboratory resources can be shared by many institutions and students worldwide, which can save much money. There are many applications and advantages of virtual laboratories as their implementation in distance education or the acquisition and management of expensive tools and machinery that is not easily acquired.

Therefore, the main research question to be solved is: How to develop a virtual laboratory of basic distillation that can be handled from an electronic device (virtual reality's glove), to support the teaching process of distillation? From the previous question and development experience of the research group in this type of tool, the following questions arise also be solved with the investigation: How to design and develop a motion capture device that allows sense signals generated by a hand movement? And how to design and develop a three-dimensional interface that allows displaying the manipulation of objects in a basic distillation laboratory from a remote hand and support the teaching process distillation.

II. VIRTUAL LABORATORIES

A. History Background

Due to the need for student support systems to make their laboratory practices, with the aim of optimizing time and resources required in a controlled environment to provide security, the advancement of new technologies of information and communication and adoption of recent educational and pedagogical practices, emerged virtual labs as a support for the process of student learning. The approach now in education, where new spaces are built and troubleshooting, virtual laboratories, have gone deep into the pedagogical practices, for over 25 years or so, when its use began. The first approach to virtual laboratories appears in 1984, where the concept of virtual instrument and its characteristics were determined according to the fundamentals of programming. [7]

In 1992, virtual laboratories described the object-oriented programming in the development of a laboratory simulation. In 1994 was presented a study by Vanderbilt University in the U.S. which develops a simulation-based virtual laboratory to support traditional practices, which concluded with the need for this tool to learn basic skills and equipment management, which optimizes both the time of pupils as the laboratory staff, in 1994 was written an article [8] in which is explicitly defined a virtual laboratory as a simulation program.

B. Concept

A Virtual Laboratory is an interactive virtual space that incorporates all the technological, pedagogic and human resources in order to perform practical activities, adapted to the student's and teacher's needs in a virtual learning environment [9].

The virtual laboratory is composed by a virtual world which is based on the required pedagogy by the area of science where it is implemented and the development of the virtual environment to make it comfortable and real to the student. Along with a hardware tool which is an essential resource for learning as it provides comprehensive real sense of the object that is being manipulated within the virtual laboratory.

In addition the laboratory should have the following Characterisitcs says Vikram Padman and Nasir Memon [3] Accessibility, Observability, Ability to simulate realistic scenarios, Realistic, Separability of virtual network, Remote Configurability, Ability to share resources efficiently. With accessibility it is understood that a student can easily access the virtual laboratory and its elements, the Observability characteristic is about the possibility of students to observe the effects of their actions within the virtual laboratory, as it would be in reality. real sense of the object that is being manipulated within the virtual laboratory.

In addition the laboratory should have the following Characteristics says Vikram Padman and Nasir Memon [3] Accessibility, Observability, Ability to simulate realistic scenarios, Realistic, Separability of virtual network, Remote Configurability, Ability to share resources efficiently. With accessibility it is understood that a student can easily access the virtual laboratory and its elements, the Observability characteristic is about the possibility of students to observe the effects of their actions within the virtual laboratory, as it would be in reality.

C. Importance

Despite distance education acquires some results in theory teaching, the expansion of the experiment manipulation teach has become the main factor which restricts the further development of distance education. The importance of virtual laboratories can be seen in distance education as these allow students to access information from different places, it is not necessary for them to be at the same school or even in the same location.

Engineering students need to practice and perform experiments in laboratories in order to complement their learning process. However, instructors and equipment are not always available. Additionally, there may be risk and trouble using some equipment that may hurt students or damage the equipment. [10] In these cases the use of virtual labs is the best option for engineering students where is needed to use equipment that do not have or it use is dangerous for the student. Thus, it appears that some of the main reasons for using these tool: the decrease in investment in expensive machines, the expansion in the restricted access to expensive laboratory equipment and, the limited availability of free time in laboratories for new practices to enhance knowledge on a specific issue and reducing the cost of consumable items.

III. CHEMISTRY VIRTUAL LABORATORY

The virtual laboratory was designed and is under development to support the teaching of chemistry distillation consists of three basic components: an interaction device (suits, gloves, helmet or other component that allows movement user), a motion capture device (electronic device that receives signals (movement) of the user and transmits to the computer) and a software interface (virtual world) that contains a three-dimensional scene with real-world elements simulated, which is operated with the signals received from the motion capture device. Additionally, the software interface (virtual world) incorporates in its operation a teaching model and didactic to facilitate the learning process.

The interaction device consists of a virtual reality glove which senses movements of the student's hand capturing the different activities that can do in the distillation process in the virtual laboratory implementing low-cost sensors that make the glove more accessible to all users. The motion capture device is responsible for capturing the different signals from the virtual reality glove to identify and order it with reference to the voltage found on the analog inputs of a microcontroller and then feedback a response to the virtual world of the

computer where it generates a real-time response to the action performed by the student.

IV. RESULTS

The developments achieved in the project, offer opportunities to acquire knowledge for the deployment of new virtual labs, creating virtual worlds, design and development of motion capture devices based on wireless sensors and cameras, as well deploying applications as telepresence, which can be used generically to build solutions in education, health, entertainment, industrial, etc.

The project helped to identify mechanisms to incorporate the teaching model of problem solving within the operation of the virtual world, which has facilitated the use by students of the device.

The construction of the laboratory includes the formation of a task force comprised of people from different professions (system engineers, electrical engineers, designers, educators, teachers and students of the subject of chemistry), who have worked in an organized and have allowed the approach new projects, seen from different perspectives.

V. DISCUSSION

The design and development of virtual laboratories oriented to education should consider incorporating educational and teaching models, because it facilitates the use and student motivation to perform the various practices in the laboratory.

The practices that students will perform in the virtual laboratory, must be integrated with the programming being done by the class teacher, as this allows better results in the transfer of the different concepts.

The development team of a virtual laboratory oriented to education must have professionals from different areas such as systems engineers, electrical engineers, designers, educators and experts in the field that allows the construction of the laboratory from different perspectives.

VI. REFERENCES

[1] Zhu Yonghua, Pan shunhong, Dong Zhiling and Yao Hong, “An Interactive and Expansible Virtual Laboratory Environment for Hardware Chips Application Experiment”. Proceedings of the First International Workshop on Education Technology and Computer Science, 2009.

[2] Virginia L. Stonick, “An update on the cmu virtual laboratory”. Electrical and Computer Engineering Department. Carnegie Mellon University, Pittsburgh, PA. 1994.

[3] Vikram Padman, Nasir Memon, “Design of A Virtual Laboratory for Information Assurance Education and Research”. In Proceedings of the 2002 IEEE Workshop on Information Assurance and United States Military Academy 2002.

[4] Zhao Ya, Liu Xianmei and Wu Qiong, “The Research and Implementation of Virtual Laboratory based on Web in Distance Education”. In Proceedings of the 4th International Conference on Computer Science & Education 2009.

[5] Mora, William, Garcia, Alvaro, “La resolución de problemas: una línea prioritaria de investigación en la enseñanza de las ciencias”, In línea de investigación en docencia de la química, Proyecto Curricular de Licenciatura en Química. Universidad Distrital Francisco José de Caldas. 2008, P. 15-17.

[6] Gu Rong, Zhu Miaoliang, Dong Yabo, Shi Dandan and Wang Yonggu, “A Case Study of Virtual Circuit Laboratory for Undergraduate Student Courses”, In ITHET 6th Annual International Conference. Juan Dolio, Dominican Republic 2005.

[7] Rodrigo, V., and Ferrando, Miguel., “Virtual Instrumentation: First step towards a virtual laboratory”, In IEEE International workshop on virtual and intelligent measurement systems. Annapolis, Maryland, 2000.

[8] Goldberg, K,. “The Mercury project – Robotic tele-excavation. Beyond the Web: Excavating the Real World Via Mosaic”. In The International WWW Conference. Chicago, 1994.

[9] Prieto-Blazquez, J.; Garcia-Tora, I.; Herrera-Joancomarti, J.; GuerreroRoldan, A.-E., "Virtual Laboratory ontology for engineering education," Frontiers in Education Conference, 2008. FIE 2008. 38th Annual , vol., no., pp.S2F-1-S2F-6, 22-25 Oct. 2008.

[10] Noguez, J.; Huesca, G., "LaSiTo: A lathe simulated virtual laboratory," Frontiers in Education Conference, 2008. FIE 2008. 38th Annual , vol., no., pp.S2A-13-S2A-18, 22-25 Oct. 2008.