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February 11-12, 2015 | Malang, Indonesia

Advancing to the Frontier of Innovation in Science

CONTENTS IN A BRIEF

PROCEEDINGS OF THE 5TH ANNUAL BASIC SCIENCE INTERNATIONAL CONFERENCE

"Advancing to the frontier of innovation in science"

ATRIA HOTEL AND CONFERENCE, MALANG, INDONESIA
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WELCOME MESSAGE

On behalf of the organizing committee, I extend my hands to invite you to the 5th Annual Basic Science International Conference (BaSIC 2015).

Being its fifth year, the organization of this year is a milestone for the annual Basic Science International Conference. Sitting quietly behind this milestone is a long history that records the evolution of this annual meeting. The conference was initiated on 2000 by the Faculty of Science of Brawijaya University under the humble name of National Conference of Science (*Seminar Nasional Kemipaan*). The conference then expand and change its name into Basic Science Seminar. Starting from 2006, the conference has continuously invited international participants. On 2011, the conference adopted the present name and expanded its scope to international. For more than ten years, the conference has facilitated the communication between scientists across disciplines in science.

Science is advancing rapidly and enables us to reveal and comprehend how this universe works. The scientists are naturally rewarded by the excitement to discover new things that bring them closer to the answer of their curiosity, while at the same time continuously providing contribution to human race in form of knowledge. The long contribution from the works of scientists around the world has brought us to a deeper knowledge, where the boundaries dispute between science disciplines become an obsolete issue. By promoting collaboration across disciplines, we will further extend the opportunity to discover an innovation, gain better understanding, and enhance the advancement of science body.

This event is aimed to promote scientific research activities by fellow scientists in Indonesia and overseas, in a hope to build and strengthen networks and collaborations.

With best regards,

Dr.Sc. Lukman Hakim
Conference Chairperson

WELCOME MESSAGE

On behalf of the Faculty of Mathematics and Natural Sciences, we are very pleased to welcome you in the Fifth Annual Basic Science International Conference. By conducting this conference, we can communicate our research, solving our problems and strengthening our collaborations. Thus, let us give our gratitude to the keynote speakers.

- Prof. Hideki Tanaka (Okayama University, Japan)
- Prof. Aulanni'am (Brawijaya University, Indonesia)
- Prof. Frederic Merienne (Informatique et Image at Arts et Metiers ParisTech, France)
- Prof. Fahrul Zaman Huyop (Universiti Teknologi Malaysia, Malaysia)
- Prof. Shoji Motomizu (Okayama University, Japan)
- Prof. Edy Tri Baskoro (Institute Technology Bandung, Indonesia)
- Prof. Isao Kadota (Okayama University, Japan)
- Prof. Duangjai Nacapricha (Mahidol University, Thailand)

Many thanks to invited speakers for delivering and sharing his competencies.

Thanks to all oral presenter, contributor for poster session and all of the participant for your attention, support and contribution for this conference. By providing this proceeding, we can follow-up our collaboration in research between us.

Last but not least many thanks to the steering and organizing committee chaired by Dr.Sc. Lukman Hakim for the great work to succeeding this conference.

Prof. Dr. Marjono, M.Phil
Dean Faculty of Science, Brawijaya University

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Proceeding of The 5th Annual Basic Science International Conference
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A Design of 3D Virtual Reality Chemistry Lab with Hand Gesture Interaction for Education

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Abstract – Advanced three-dimensional (3D) virtual reality (VR) technology similar to that used by the film and computer game industries can allow educational developers to rapidly create realistic virtual environment. This paper presents a design project and considers the possibilities of using 3D virtual reality and hand gesture interaction in chemistry education. The main goal in this research is to develop 3D virtual reality chemistry lab with hand gesture interaction to be use for education purpose. In this application we combined Oculus Rift 3D for displaying 3D objects and also Leap Motion sensor to interact with user by using hand gesture recognition. We prepared 3D objects such as Laboratory space, chemistry laboratory common apparatus, and also chemical experiment simulator that can be explored by student.

1. INTRODUCTION

Many have argued that interactive 3D virtual reality environment have great educational potential due to their ability to engage learners in the exploration, construction and manipulation of virtual objects, structures and metaphorical representation of ideas [1], [2]. 3D virtual reality play a major role in education not only because they provide realistic models with which students can interact to acquire real world experiences, but also because they constitute safe environments in which students can repeat processes without any risk in order to perceive easier concepts and theories. An educational virtual reality environment can be defined as one or more virtual worlds that offer multiple educational functionalities to each user-student. Within these virtual worlds, students can navigate, interact with virtual objects and study the educational material, which can be a 3D model or even text, image, sound or video. By using virtual reality technology engages students' attention and turn learning into pleasant and entertaining process like playing a game. The main features of these applications: immersion, interactivity and in 3D.

E. Altun, etc., mentioned about problems in order to accomplish laboratory applications in chemistry. Laboratory applications are complementary of chemistry instruction and they are major parts of chemistry lessons. However, at some schools, laboratory applications of chemistry courses are missing because of the following reasons: absence of chemistry labs, sharing laboratory with physics, chemistry and biology course, insecurity in labs because of dangerous chemicals, crowded classrooms, lack of time, lack of materials, cost of equipment, and also incapableness of teachers using labs effectively and their negative attitudes towards laboratory applications [3]. J Georgiou, etc., mentioned that by implementing virtual reality technology give a lot of benefits [4]. Ali, N., etc., built Multimodal VR chemistry lab [5], but in that application the user interaction still using mouse and keyboard.

In this paper, we present a design of 3D virtual reality chemistry lab with hand gesture interaction for education. We develop a basic 3D objects such as laboratory space, chemistry laboratory common apparatus, and also chemical experiment simulation program that built by using Unity 3D engine which equipped with combination of Oculus Rift 3D for displaying objects and also Leap Motion sensor to interact with user by using hand gesture.

The rest of the paper is organized as follow: Section 2 explains about system overview from our 3D VR chemistry lab. Section 3 presents our implementation or Virtual Lab. Section 4 concludes this paper and with some future works.

2. SYSTEM OVERVIEW

Figure 1 shows about system overview of 3D VR chemistry lab. The 3D VR chemistry lab design is based on Unity 3D engine. Unity 3D [6] is a cross-platform game creation system. On top of the Unity 3D engine we provide 3D and non-3D objects to interact with user. In this system also can be connected to other learning applications such as PyMol or WebMo. The input system used a Leap Motion [7] sensor that has ability to recognize hand gesture movement, and we used Oculus Rift 3D DK2 [8] headset to produce 3D VR output.

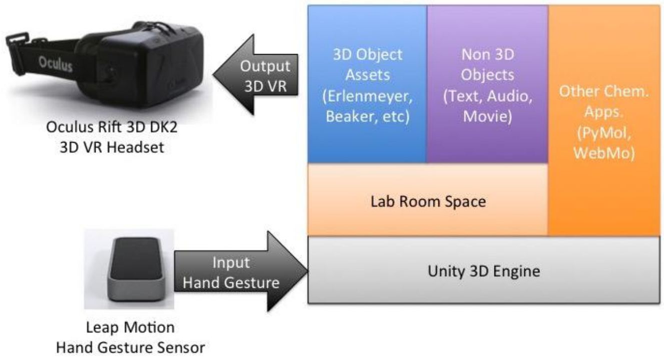

Figure 1 System overview of 3D VR Lab.

2.1 Unity 3D Engine

It is a 3D game engine developed by Unity Technologies, and is a data tool used to make games, contents, real-time 3D animations, etc. It can be run on Windows and Macintosh OS X, and be used for development on various platforms including Windows, Mac, WII and iPhone. It can be used to make 3D web games utilizing a Unity web player plugin. It provides easy and stable development environments compared to other game engines, it has an advent of a high development success rate. The most distinct characteristics of the Unity3D engine are easy development environment and multi-platform environments that can be easily conversed. Unity3D support multi-platform environments such as Windows and Mac, Xbox360, PS3, Wii, Android, IOS, Explorer, Chrome, Safari, Firefox and cab be run on Windows and Mac. Unity 3D supports three script languages, they are Java script, C#, and Boo. They all enable quick interactions that can utilize the .Net library, and support database, regular expression, XML, networking, etc. Unity engine provides library for user interaction by using Oculus Rift 3D and also Leap Motion sensor.

2.2 Oculus Rift 3D DK2

The Oculus Rift is a headset that allows a user to step into the game and look in any direction. The Oculus Rift is currently present in developer kits version two (DK2). The oculus rift head tracking lets the user look around the virtual world just in the manner they would in the real world. The oculus rift head tracker constantly analyzed the player's head movement and uses it to control the view, instead of relying on a mouse or analogue stick to turn your view in the game.

Oculus rift DK2 involves position tracking which allows the user to lean in for a closer look at an in-game objects or panel, or peek around a wall by moving their head and upper body, and seeing their physical actions translated into the virtual world. The movement directions of the user who used oculus rift DK2 can be seen in Figure 2.

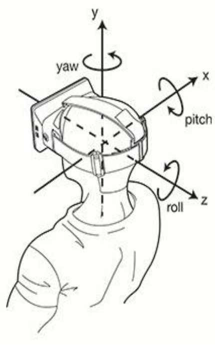

Figure 2 An illustration of the 3-axes.

2.3 Leap Motion

The Leap Motion controller is a small USB peripheral device designed to be placed on physical desktop, facing upward. Using two monochromatic IR cameras and three infrared LEDs, the device observes a roughly hemispherical area, to a distance of about 1 meter (3 feet). The LED generate a 3D pattern of dot of IR light and the cameras generate almost 300 frame per second of reflected data, which is then sent through a USB cable to the host computer, where it is analyzed by the Leap Motion controller software using "complex maths" in a way that has not been disclosed by the company, in some way synthesizing 3D position data by comparing the 2D frames generated by the two cameras. The hand gesture movement of the user who used leap motion can be seen in Figure 3.

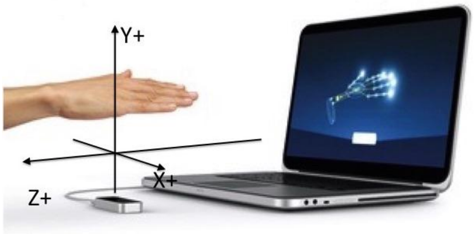

Figure 3 Leap Motion Controller Coordinate System.

2.4 Assets

The main objects from 3D virtual environment is asset, in this VR lab we used 3 assets. Those assets are laboratory space, 3D objects and also non-3D objects. The assets example can be seen in Figure 4

Figure 4 Assets: (A) Lab space, (B) 3D objects, (C) Non 3D objects.

3. VIRTUAL REALITY LAB IMPLEMENTATION

In this section, we explains about implementation of 3D VR chemistry lab. The implementation system can be seen in Figure 5. They are 2 main implementations for this project: VR space, and User interaction.

(a) (b)

Figure 5 User interactive in 3D VR chemistry lab: (a) system, (b) demonstration.

3.1 VR Space

Figure 6 VR lab space, chemical apparatus and experiment manual.

Figure 6 showed about the implementation of VR space, we built 3 types of asset. These assets are: (A) Lab space, (B) 3D Objects and (C) non 3D objects. For Lab space we created a room that already equipped with lab furniture such as, room space, table, lighting, and wall. The 3D objects that we created are chemical apparatus equipment such as beaker, microscope, test tube, Erlenmeyer flask, funnel, Titration tool and dropper pipet. And the additional asset is non 3D objects, we built a menu button, user/student name and id, experiment manual, help button, pause button and also time.

3.2 User Interaction

They are 4 types of user interaction in our project, they are: user movement, holding an object, turning a knob and also touching a button or area. The implementation of user interactions can be seen in Figure 7.

By moving our headset forward, backward or turn left/right, we can control the movement of user object inside VR lab space. Oculus Rift provides zoom view by moving our head in front or backward. And when we turn our head, we can see whole room environment.

Unity 3D engine provides physics engine, its means that objects inside of VR environment can collide with each other like in the real world. By those features, user hand that detected by Leap Motion sensor can hold an object and also turn a knob. With touch emulation from Unity and Leap Motion SDK provides an adaptive touch surface that can interact with 2D element inside of application.

(a) (b) (c)

Figure 7 User interactions: (a) holding an object, (b) turning a knob, and (c) touch an area.

4. CONCLUSIONS

We developed a novel 3D virtual reality chemistry lab with hand gesture interaction by utilized Oculus Rift DK2 and Leap Motion sensor. For future works we will add liquid physics engine and provide another scenarios in chemical experiment.

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