VIRTUAL REALITY-BASED ENGINEERING EDUCATION

BY

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Thesis titled "**A Virtual Reality-Based Engineering Education Approach**", submitted by Shomitro Kumar Ghosh, ID No: 161-15-7573 and Md Toheen Bhuiyan, ID No: 152-15-5981 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 5th December 2019.

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DECLARATION

We hereby declare that, this thesis has been done by us under the supervision of **Dr. Md. Ismail Jabiullah,** Professor of Department of CSE Daffodil International University. It is also declared that neither this project nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.

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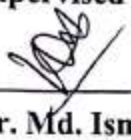

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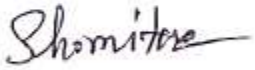

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ABSTRACT

Uses of virtual reality are very much increasing day-by-day in the era of science and technology. Many areas of engineering education, training, demonstration, automotive industry, retail, real estate, tourism, architecture, healthcare, gambling, recruitment, entertainment, sports, design and art, events and conferences, well-being, social, charity, marketing, recreation, law enforcement, news and journalism, researches and others sector using virtual reality offers more innovative and challenging opportunities. The cost of virtual reality is always very high. In virtual reality area, learner can improve their skills and knowledge by using the different tools, techniques and processes and reduces the cost. After improving software and hardware, tools and instruments by virtual reality all sectors and mostly education sector are now in easier, sophisticated way, attractive and cheaper. Here, more difficult problems like as 3D digital technologies, medical training, and military training etc. in engineering education are presented and analyzed by using the implementation of virtual reality, so that the learner's get educational benefits by using virtual reality technics.

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CHAPTER 1

Introduction

1.1 Introduction:

Virtual Reality (VR) alludes to the computer – generated reproduction in which a person can connect with a fake three-dimensional environment using special electronic machine, for example, special googles with a screen or gloves sensors. In the artificial environment, the client can investigate the different curios and proceeding as they may in real world. At first when we normally think of Virtual Reality out first idea is to go to a modern VR headset as well as of the different Computer application which are beginning to include Virtual-Reality support. Virtual reality (VR) has a wide history with an idea that dates right back to the 1930s. In this article we will talk about the history of VR and how it developed since an early concept into the simulation experience that you can have in your home at present day. Currently, VR headsets get accept input from two various sources: - one is HDMI cable that is either connected to a computer or comfort or a cell phone, the previous

Fig. 1.1: VR Technology

applies to headsets, for example, the HTC Vive and the Oculus Rift, while the latter is used with googles Daydream and Samsung's Gear VR headsets. Another one is also you can connect other device like as head and hand tracking, controllers and voice input- to your VR headset. It is possible that a couple of screens for each eye get two feeds, as well as autofocus lenses that are positional between your headset's screen and your eyes. These can be balanced relying upon both eye development and situating. Their different capacities incorporate picture focusing and reshaping for each eye. And tilting two 2D pictures to delivers to stereoscopic 3D picture that imitates how our eyes see the world. A few VR headsets have a base 100 or 110-degree field of over view for a more immersive VR experience. For the image produced by these device, a minimum frame rate of 60fps is required to make it convincing without making the use feel sick.

1.2 Motivation:

VR is really amazing part of modern science. Virtual Reality immersive tricks the brain into the body is really in the Virtual environment. We learn Virtual Reality's many topics like as VR online shopping, VR training, VR in medical Science and many others. But we select Virtual Reality based Education topics. Then we think if we implement engineering education with virtual reality, this is an achievement for us and also students are change their mind and enjoy this engineering learning. So we decided to work on Virtual Reality education.

1.3 Rationale of the Study:

Virtual reality is an experience which can be similar or different from the real world. Virtual reality basically used for entertainment and for education. It established many things for the entertainment and education. Currently standard virtual reality is used for the things like virtual reality handset or multi-project environment to generate the realistic images, sound and other sensations. In entertainment sector virtual reality used for exhibit, concert, museum, gallery etc. We can view 3D images with that system. So virtual reality brings enjoy for the entertainment sector.

Virtual reality is also used for gaming. Many computer games used the virtual reality

system for true immersive and first-person perspective of game action. VR is also used for education. It is used for better student learning and engagement. Educational contents can be transform by it. It can create virtual word real image. So we can't only see but we can realize and interact with it.

So, for the variety of the work of virtual reality, we decided to work with virtual reality. We work with virtual reality for the educational purpose.

1.4 Research Questions:

A research question is an inquiry that a research project sets is out to answer. When we want to research about VR then we find out what is our goal is? After that, we select our field which is based on some target questions. The main questions are given below:

Q.1: How to improve and enjoyable education system using Virtual Reality?

Q.2: Can Virtual Reality be a Substitute for Real Life Experiences?

Q.3: What is the most important challenge in Virtual Reality?

1.5 Expected Output:

This paper has tried to represent the "Virtual Reality on Engineering Education". By using Virtual Reality educational system students are more comfortable and entertainment for learning. Now Virtual Reality is very costly project, that's why all students or institutions are not bear this approach. At first we want to know engineering students how to fell about this new educational system.

Fig. 1.2: VR Wearing Students

1.6 Report Layout:

The following report consists five chapters. chapter 1 is the Introduction, which highlight the motivation and goals behind the thesis. Section 1.1, 1.2,1.3,1.4, 1.5 and 1.6 titled introduction, motivation, rationale of the study, research questions, expected output and report layout.

Chapter 2, titled background, perquisite information relevant to the thesis and it divided into four sections 2.1, 2.2, 2.3 and 2.4 titled introduction, review works, scope of the problems and challenges respectively.

Chapter 3 illustrates the details of this thesis experiment spanned four subsections titled research methodology. Sections are 3.1, 3.2, 3.3 and 3.4 explain each phase of the recognition, i.e. introduction, research Subject and Instrumentation, comparative analysis and implementation requirements. Section 3.3 in comparative analysis it has a table and we gave some analytical data with the propose system, and the last one Implementation Requirements.

In chapter 4, titled Experimental Result and Discussion. It has four section where we mentioned the experimental result and discussion of that result. It has three section 4.1, 4.2, 4.3 and 4.4 and titled introduction, experimental result, benefits and summary.

Finally, chapter 5, titled Conclusion. It has three section there are Conclusion, Summary of the study, Future work and Benefits.

Before the ending, there is reference to reading materials that are referred to during this research. Finally, ended this thesis by described the appendix. It has Five sections. Sections are 01, 02, 03, 04 and 05 title Introduction, Background, Research Methodology, Experimental Result and Conclusion and future works, Research. details (Monthly) report with supervisor and research materials used in this study.

CHAPTER 2
Background

2.1 Introduction:

Virtual Reality (VR) is an impetuous development of technology leading to amazing change in human life. This VR technology delivers us new educational thinking and deals with difficult problems. Computerized systems provide a wide variety of learning approaches such as multimedia presentations, teaching tools, realistic simulations of situations, complex question-and-answer sessions so that students can be benefitted. Besides, some of the approaches are quite costly and hazardous to bring in the classroom in reality. As a result, the usage of computers is increasing more and more as it provides a better education. So, VR technologies are now developing widely and new methods are continually emerging.

The Virtual Reality engineering lab teaching system has a complete engineering method. The lab operator handles the engineering method of the classroom of different virtual environments through the controlled device. The user can experience and notice different elements at a closer range.

Students can know the better of all engineering experiments, although immersive learning, learners better immersed in their own, feel the presence of learning and fun. During the observation process, the lab operator can also be in the hands of the controller for the required observation of the engineering method to observe the beginning of the lab operator can be the best visual point of observation and learning, this is completely beyond the reach of traditional teaching methods and effects clearly. Each method with a voice introduction, the operator in the process of operation effects due to the impact of voice through immersive learning. In subtle natural learning and objective this part behaves as a traditional learning. Finally, by using the VR technology, engineering methods can easily be understood to all the learners. So, teachers not only can guide students to learn, but also can explain other students synchronously though the display screen using in the VR environment. Most of the engineering sectors using this classroom like as Computer

engineering, Chemical engineering, Civil engineering, Mechanical engineering, Architecture engineering, etc.

In this paper, an engineering educational class is designed and developed with the VR equipment for some students and implemented for taking the class in VR environments. In the class, students wire the VR devices and feel the thrills of using the VR classroom,

gather the engineering knowledge more effectively and with better understanding and realization of the engineering know-how.

2.2 Review works:

1. **Military:** The military in the UK and USA have both received the utilization of VR in their training as it accommodates to embrace a tremendous scope of reenactments. This is used in all branches of service. VR can put a trainee in a various number of different situations, like as battlefield simulation, war zone sports and conditions so the military are using fight simulations, surgeon training, vehicle simulation and virtual training camp etc. A key advantage for the utilization of VR military is the reduction in costs. In addition to this, VR technology can safely duplicate dangerous training situation.

Fig. 2.1: VR Military Training

2. **Sport:** In sports sectors VR is changing the sports Industry for both plyers and viewers. It is utilized as a preparation help in numerous games and to help measure athletic performance and analyses system. Some NFL and NCAA groups are utilizing computer generated reality innovation gave by STRIVR, a VR organization, to improve their instructional meetings. ... During preparing, players wear headsets that empower them to see different situations including how an up and coming adversary moves over the field.

Fig. 2.2: VR Sports Time

3. **Mental Health**: Virtual Reality (VR) has become an essential strategy for treating post- traumatic stress. Using VR exposure therapy, a person enters a re-enactment of an injurious event.

Fig. 2.3: VR Health Care

It has likewise been utilized to treat uneasiness, Aversion and depression. VR technology can give a protected environment for patient to come into contact with the things they dread. While staying in a controlled and safe condition

4. **Education:** VR has been adopted in education for learning and teaching position. Students can connect with one to another and inside a 3D condition. Students can also be taken on VR field trips, like as to exhibition halls, taking tours and solar system and returning so as to various times.

   Students with exceptional needs, such as autism are also VR technologies. Research has discovered that VR can be a propelling stage to securely rehearse social skills for children. An organization called Floreo has developed VR scenarios that agree children to learn and practice skills such as pointing, looking and building social associations**.**

Fig. 2.4: VR Education Sector

Here at FDM we've additionally been embracing VR. Previous year we gave our summer intern group a breathtaking project to take a shot at make 360° VR video that could be utilized at University recruitment fairs. The VR headset enables students to immerse themselves in the FDM office and experience the association in the computerized world.

VR is still now its beginning stages; it will be interesting to see how it develops in the years to come as the innovation is turning out to be expensive and increasingly across the board.

5. **Medical training:** Medical and Dental students use VR technologies to patient surgeries and procedures, considering an outcome free learning condition. Virtual patient is utilized to enable understudies to create abilities which can later be applied in reality.

Fig. 2.5: VR in Medical Training

2.3 Scope of the problems:

When we start work with Virtual Reality based education approach, we face many problems.

- VR headset is very expensive
- VR instrument managed is a big challenge
- It's a new approach

VR headset is costly so here we use google cardboard for this research. We face another problem for this research. We need a digital classroom but all institutions have no digital classroom. But we luckily found a digital classroom in our University.

2.4 Challenges:

When we thinking about Virtual Reality based Education, it's a fully new topic for us and others. A big number of people don't know about Virtual Reality Technology. Other site engineering education many practical topics are don't understand students. But Using Virtual Reality Technology we can easy that topics and get them interesting theme.

We want to try some problems solutions.

Those problems solutions are –

- They learn with entertainment
- Learn with a clear concept
- Learn more practically

All are big challenge for us. Because new technology new people and some unique research.

CHAPTER 3

Research Methodology

3.1 Introduction:

Virtual Reality (VR) has entered the universe of education though the making new resource to learning and teaching. If student entire a 3D digital environment that helps them much information and everything is more comfortable, exciting, enjoyable and funny. Virtual Reality agree to people travel without leaving the class room, explore, given opportunities what are the student want to learn without moving, have a more remarkable expert direction and significantly moreover achieved a worthy level of improvement for it to be considered in creative applications, like as training, education, research in higher education. VR technology given both opportunities and challenges for the educational area. Cost of Virtual Reality are very high, most of educational institutes can't bear the instrumental cost of this technologies. However, in recent years' computer hardware and software development has made it more efficient to users.

3.2 Research Subject and Instrumentation:

Our research subject is Virtual Reality Based Engineering Education. We Find virtual reality based many works, like as virtual reality based medical learning, virtual reality based online shopping, virtual reality based games and many others. But we are interest to Virtual Reality Based Engineering Education.

For this research we most of the instruments are create, like as virtual classroom. And we use some hardware, example: VR Headset, Headphone, Android Device and some learning 3D Videos.

3.3 Comparative Analysis:

The proposed system has been implemented in a class room of the Daffodil International University which has 23 students with the VR equipment. Students using in this class are found very much excited for learning the matters and all of them are found very happy.

Among all the students a combination of the two methods are working with the proposed method and the comparative output is presented in the following table.

Table 1: A Comparative Analysis with the Proposed System

Methods/Characteristics	Positional Tracking	Audio Input/Output	Real World Environment
Head Mounted VR	√	√	√
Simulation-based VR	√	x	√
Proposed Method	√	√	√

3.4 Implementation Requirements:

To implement the virtual reality enabled class room environment we need some instrument

a) Android Device with at least 2 GB RAM

b) VR headset

c) Screen display at least 5.0 inches,

d)Android 5.0 higher (For iPhone iOS 8 or higher)

e) VR app- Cardboard or VeeR,

f) High Quality Headphones for Immersive Experience

CHAPTER 4

Experimental Result and Discussion

4.1 Introduction:

VR technologies are now developing widely and new methods are continually emerging. The Virtual Reality engineering lab teaching system has a complete engineering method. The lab operator handles the engineering method of the classroom of different virtual environments through the controlled device. The learner can be understanding and notice various components at a closer range. Student can know the better of all designing analyses, learns better immersed in their own, feel the presence of learning and fun. Uses of virtual reality are very much increasing day-by-day in the era of science and technology. Many areas of engineering education, training, demonstration, researches and higher education using virtual reality offers more innovative and challenging opportunities. The cost of engineering education is always very high. In this area, learner improves their skills and knowledge by using the different tools, techniques and processes and reduces the cost. After improving software and hardware, tools and instruments by virtual reality the engineering education are now in easier, sophisticated way, attractive and cheaper. Here, more difficult problems like as 3D digital technologies, medical training, and military training etc. in engineering education are presented and analyzed by using the implementation of virtual reality, so that the learner's get educational benefits by using virtual reality technics.

4.2 Experimental Result:

There are some methods for implementing the Virtual Reality (VR) and they are: Simulation-based VR, Project-based VR, Desktop-based VR, Head mounted display VR, Avatar Image-based VR, etc. To implement the virtual reality enabled class room environment 2 GB RAM, VR headset, Screen display at least 5.0 inches, Android 5.0 higher (For iPhone iOS 8 VR technology has been implemented in a class room in the Computer Science and Engineering Department of the Faculty of Science and Information Technology of the Daffodil International University (DIU), Bangladesh as a test case. For

that a VR device is installed and set to the students of the class. The students have enjoyed the environment and also filled thrill in the class. Without the VR device the class has been performed and enjoyed for some engineering topics on a class of students. And also the class with the VR devices in the same set of students and the same topic has been taken and measured. The engineering class with using the VR devices is found better. The implemented class environment with using the VR devices are depicted in the Fig. 4.1, Fig. 4.2 and Fig. 4.3.

Fig. 4.1: Students Wired the VR Device

Fig. 4.2: VR Setup Class Room

Fig. 4.3: Students Feel the VR Class Device

4.3 Benefits:

Applications of Virtual Reality has some benefits. The identified benefits of Virtual Reality applications are presented below.

(a) Increase knowledge area
(b) Active experience rather than just passive
(c) Helps to understand complex concepts, subjects or theories
(d) No any distractions while the study
(e) Boosts student's creativity
(f) Creating Interest
(g) Improves Educational Value
(h) Expands learner's efficiency to gain knowledge
(i) Outstanding Visualization

4.4 Summary:

Virtual Reality in education helps students learn new things by immersing them in a world, complementing their learning with alternative ways of seeing their content. We research on some students and get some good feedback. They fell real life lab experience and enjoy this type of engineering education approach. We are very inspiring from there and in future we try to more experiment to virtual reality education and try to best research with this virtual reality based engineering education.

CHAPTER 5

Conclusion, future works and Research

5.1 Summary of the Study:

Virtual reality education is modern learning system. Nowadays Virtual reality (VR) technology is popular in advance fields of education, medicine, engineering, design, training, and gamming entertainment. All VR sectors improve and popular day by day.

We trying to improve virtual reality and learn engineering education with entertainment by real fell. And Students or Teachers are enjoying this learning approach.

Virtual reality has the potential to make new revelations and have a positive effect in multiple areas of our regular day to existences. At the point when it's too dangerous or costly to give something a short in actuality, VR is an extraordinary choice to have.

5.2 Conclusion:

A virtual reality based class room has been designed and developed for a group of students for Department of computer science and engineering department in the Daffodil International University and has been implemented for an engineering class. It is found as the doorstep of engineering education system that will change the classroom as the technologically advanced place of learning. It is realized that by using VR technology a significantly increasing student's engagement is found in learning system. This can be applied for all engineering education system where it be needed and will be appropriated.

5.3 Future work:

In near future, we will see speedy advancements in making a really immersive digital experience. With significant players Microsoft, Goggle, Oculus and HTC trying huge effort to develop the present abilities, we are not a long way from achieving a virtual reality world that would feel such a great than the real world. In present the VR technology countless opportunities. Using this approach, they won't win upon users yet additionally set up themselves as the pioneer in advancement. If would like to develop a VR application for the business to feel free to get touch, with more than 10 years of involvement with portable

innovations, we can make every dream a reality. This Virtual Reality process has more improve Virtual Reality based engineering education. So we research more and get feedback from teachers and students. In future we hope improving virtual reality based engineering education approach and try to reduce Virtual Reality equipment's. If we do that it's a great achievement for us and all people who want to learn from virtual reality based education. We want to create Bangladesh's first Virtual Reality classroom at Daffodil International University.

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APPENDIX

Table 2: Contributed Publications from This Study

Sl.No.	Titles	Year	Journal/ Conference
01	On The Use of Virtual Reality-Based Engineering Education	2019	2nd Connect-Us Conference (CuC) 2019, Malaysia
02	On The Use of Virtual Reality-Based Engineering Education	2019	Journal of Business and Economics, Academic Star Publishing Company, USA

Table 3: Contributed Other Publications

S.No.	Titles	Year	Journal/ Conference
01	A Steganographic Apps-based Patient's Information Encryption-Decryption	2019	International Journal of Recent Technology and Engineering (IJRTE), India
02	A Study on the Challenges and Solutions of Cryptocurrency	2019	10th ICFC 2019, Bangladesh
03	An Evaluation of Cryptocurrencies as Online Payment System	2019	10th ICFC 2019, Bangladesh
04	A Two-layer Strong Authentication for Establishing Secured Video Conferencing	2019	National Conference on Electronics and Informatics-2019

1. Published Publication Some Images:

Fig. A1: Cuc-2019 e-proceedings Cove Book in Online

Fig. A2: Cuc-2019 e-proceedings our paper's page

Parallel Session Schedule

Business & Advanced Technology Centre (BATC)
UTM Kuala Lumpur, Malaysia

Session 1: Education

Session Chair: Prof. Dr. Rolf Schaeren (FHNW) and Assoc. Prof. Dr. Dao Ha (BUH)
Assistant Chair: Ts Dr Habibah @ Norehan Haron

No	Time	Title and Author Name
	1400-1405	**Introduction**
1	1405-1415	**Tan Luc Phan, Dong Phong Nguyen and Angelina Nhat Hanh Le** *A Bibliometric Analysis of Human Resource Management in Higher Education Research*
2	1415-1425	**Ryan Glenn Narvasa** *E-learning Readiness in Establishing an Institutional Instructional System: An Organizational Development Study*
3	1425-1435	**Beat Hulliger** *Skills for Business Analytics and Academic Curricula*
4	1435-1445	**Ahmad Asmawi Abdul Samat** *Overview of Malaysia e Government Online Services through Benchmarking*
5	1445-1455	**Shomitro Kumar Ghosh, Md. Toheen Bhuiyan, Md. Ismail Jabiullah and Raihan Chowdhury** *On the Use of Virtual Reality-Based Engineering Education*
	1455-1500	**Concluding remarks**

Fig. A3: Cuc-2019 Conference's Parallel Session Schedule

2. Research Materials used in this study:

This section shows some research materials that were used and supported during this study. In a word, it will describe the whole research activities at a glance.

Fig. A4: Students Feel the VR Class Device

Fig. A5: Students Feel the VR Class Device

Fig. A6: Students Feel the VR Class Device

Fig. A7: Students Wired the VR Device

Fig. A8: Students Wired the VR Device

Fig. A9: Some Excrement Time Captures

Fig. A10: Some Excrement Time Captures

Fig. A11: Special Thanks to these Peoples for Helping During this Thesis

Virtual Reality1

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