

Assessing the Effectiveness and the Global Trends of Virtual Reality Technology as Part of Military Training Programs Attended by Sri Lanka Army within the Past Decade

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Abstract— Virtual reality (VR) is a technology which allows a user to interact with a computer-simulated environment, whether that environment is a simulation of the real world or an imaginary world. It is the key to experiencing, feeling and touching the past, present and the future. It is the medium of creating our own world, our own customized reality. In military, new technologies are used to improve the process of training and development of skills of military people. Virtual Reality and its use in military applications has long been discussed, one of the main challenges face by country like Sri Lanka is lack of knowledge about devices and unaffordable price for military institutes. Simulators and virtual environments are powerful tools to train people in "reality-like" situations with various of training environments that Sri Lanka does not have. For the years Sri Lankan militarists participated to trainings which used Virtual Reality technology as aid of training program. This militarist have experience the difference between virtual training environment and live environment training. Implementing Virtual Reality training has the potential to create high quality, competence-based soldier with high mental demand, physical demand, temporal demand, high performance, effort and frustration level. Soldiers can involve in interactive scenarios with Virtual environment that would have been possible in previous years. The purpose of this study is to conduct a systematic review to determine the effectiveness of virtual reality (VR) training in Military. Most significantly, this study also provides a baseline for evidence that virtual reality is most suitable and trending technology for effective training than typical training programs.

Keywords: Virtual reality, Military trainings, , systematic review

I. INTRODUCTION

Human beings experience reality by the key senses such as taste, touch, smell, sight and hearing. Human brains have special processing mechanisms of sensory information to respond to input information. Unlike the above mentioned 'real reality', virtual reality technology makes human a real part of simulated artificial virtual world other than traditional user interfaces.

Virtual reality immersed virtual environment and give ability to manipulate objects or perform a series of actions to interact with 3D worlds in virtual environment by recreating a real life environment or situation instead of viewing a screen in front of them.

VR applications are used in the main industries such as medicine, education, entertainment and military. Beside the entertainment industry, Virtual Reality is used in military operations and last year major countries in the world invested millions of dollars to research and development projects based on VR.

This paper attempts to provide a general introduction to the new trends in the military Virtual Reality training applications used all over the world. The study discusses about the practical difficulties faced by the militaries during live training, and how to reduce these issues. It also identifies mechanisms to use VR technology applications and approaches to new training concepts that can be develop by the past experience gained by the military training attendances.

A. Difference between Augmented Reality and Virtual Reality

Virtual reality offers a digital recreation of a real-life setting, immerses users in a fully artificial digital environment. While augmented reality delivers virtual elements overlaid by virtually enhanced objects on the real-world environment and users see and interact with the real world while digital content is added to it via modern smart phones or digital devices such as google glass and AR head set.

The diagram below describes the virtual reality offers a digital recreation of a real-life setting, while augmented reality delivers virtual elements as an overlay to the real world.

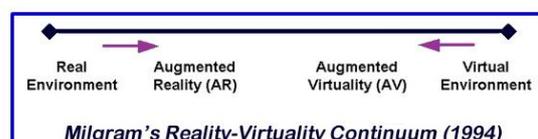


Figure 1. Milgram and Kishino's Mixed Reality on the Reality-Virtuality Continuum

Source: www.researchgate.net

Military Expenditure in Sri Lanka was USD 1710 million in 2018. One third of the above budget was used for training programmes. Training is the means to achieve the tactical and technical proficiency that soldiers, leaders and units must have in order to enable them to accomplish their missions. Realistic training is designed to counter paradigm shift in enemy sphere. Therefore, it is imperative that all commanders keep themselves fully abreast of the latest developments in tactical, technical and administrative doctrines to ensure all officers and men are trained in new techniques and skills involved with enhancing the virtual reality technologies. This study, therefore, attempts to answer the following questions:

- What are the new Virtual Reality trends used in military training programmes?
- Is there effectiveness of utilizing a virtual simulation in military training programs?
- What are the perceptions and awareness of Sri Lankan military communities about virtual reality technologies?

B. Background to the Study

Virtual reality is a new concept to Sri Lanka. Very few areas use VR technology such as entertainment and education areas. There is no VR concept introduced to medical and military training aspects due to the lack of research and development funds rather than expert knowledge.

Along with entertainment, the military was one of the first industries that invested a lot of money into the development of virtual reality applications, VR headsets, and VR platforms. That also played a significant role in the advancement of VR technologies worldwide.

The telecom service provide, Dialog, was the first to introduce the first-ever virtual reality application for Sri Lanka, featuring historical locations, edutainment and local entertainment. Dialog's virtual reality platform is the first such platform in the island to integrate 360° pictures, videos, games and advertisements, whilst it is billed to develop a crowd-sourced VR data-driven platform allowing users to create and upload their own VR content. Compare to Indian military technology both Pakistan and Sri Lankan militaries are in behind the queue. Sri Lanka Army follows the British doctrine and field manuals. Those were made with past experiences years ago such as World War 1, World War 2. Due to that reason some of those theories do not suit the present context and with the development of technology those theories to be renewed

to tackle the present threats. Due to Sri Lanka's political instability and the 30 years of civil war the training and research areas not developed compared to India.

There is a project 'Cyber Voyage' in progress using 2D technology to link available geographic data into geospatial references that support any decision maker to take decisions not only based on information but also based on their geographical deployment. But still no technology or sharing network operations exist to make simulated environment combined with only geographic data to create Sri Lankan virtual environment at present. One of the major advantages of employing virtual, constructive and game-based simulation for training are their associated cost advantages (Orlansky, et al., 1994; Riecken, et al., 2013) compare to training in live environment. In the current financial condition, this is of fundamental significance as spending plans for training keep on declining. Furthermore, the United States Army continues to employ simulation-based training (SBT) in novel ways (Mishkind M. C., Boyd, Kramer, Ayers, & Miller, 2013). This is largely due to its proven effectiveness in training and the need to decrease the cost of that training. In acknowledgment of the adequacy of SBT, the Army's Learning Model expressly calls for the expanded utilization of virtual training, as this class of re-enactment enables the Army to keep up Soldier capability in basic abilities at diminished expense cost (Stafford & Thornhill II, 2012).

Virtual world training is still an emerging technology for military training in Sri Lanka. Recent advancements in simulation technology have enabled the rendering of sufficiently realistic virtual world environments that may support effective training rather than in live environment. But the soldiers who have participated in virtual training previously have basic knowledge and experience in the difference they felt during the training period. Those who touched and felt the virtual simulators have better understating of their improvement in both physical and psychological factors.

Effectiveness of Virtual Reality based military training has not been discussed or not deeply study in Sri Lanka. There were no sufficient exercises conduct in Sri Lanka to have better understanding about the Virtual Reality technologies in training programmes and its advantages.

II. METHODOLOGY

The main question addressed in this research is to study the training effectiveness of utilising a virtual world simulation within an operationally relevant task and Analysing the perceptions and awareness of Sri Lankan military communities about recent trend of virtual reality technologies. This Study use both qualitative and quantitative methods. The research focuses on the

collection of both qualitative and quantitative data for interpretation. Self-completion questionnaire to collect data from 90 officers from Sri Lanka Army who are in the Infantry regiments, The Sri Lanka Armoured Corps, The Sri Lanka Artillery, The Sri Lanka Engineers, Sri Lanka Signals Corps, The Sri Lanka Mechanized Infantry, Sri Lanka Military Intelligence Corps, Allied Forces (Commando and Special Forces), Sri Lanka Army Medical Corps overseas training in the time period of 2008 to 2018. All the Military Officers were followed tactical and mechanical training due to unavailability of environment facilities in Sri Lanka. The aim of the survey was to measure their understanding about Virtual reality-based trainings and the effectiveness of the trainings and awareness and understanding of the next generation virtual trends.

A. Data collection and Data Analysis

The research gathered both qualitative and quantitative data. Primary Quantitative data collected exclusively through a survey research collection done with the Self-completion questionnaire. The respondents answer and complete the questionnaire by themselves. It disseminated to 90 of army officers those who have experience or participated training programmes with the aid of Virtual reality application. The questionnaire was disseminated in two ways, those who could be reached in person were provided with a paper-pencil questionnaire while some members answered the received the questionnaire in a MS Word format via email. Content analysis is the systematic examination of text and field notes by identifying and grouping themes and coding, classifying, and developing categories secondary data collected from IEEEVR conference papers. Since 1993, the IEEE Virtual Reality conference has been the premier international venue for the presentation of research results in the broad area of virtual reality (VR).

III. DATA PRESENTATION AND DISCUSSION

A. Statistical Data Analysis from the Questionnaire

The Statistical analysis have planned to time period of three months and gather in total 90 questionnaires filled in exclusively by people who had already participated Virtual reality based trainings operations.

I. Training Background of the survey individuals

Survey sample consists of 90 army agents 85% of them are participated to VR based Trainings and 15% are do not have direct VR Based Training experience.



Figure 2. Training Background of the Survey Individuals chart

II. VR TECHNOLOGY BACKGROUND KNOWLEDGE OF THE SURVEY INDIVIDUALS

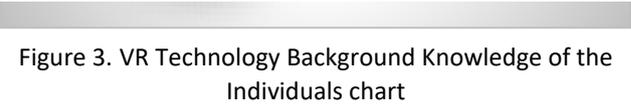


Figure 3. VR Technology Background Knowledge of the Individuals chart

50% out of sample have knowledge about the concept of virtual reality (VR) and 30% of the sample Used VR Technology in Trainings only. 15% from the sample have through knowledge about VR Technology with previous studies with their own studies or field studies. Other 5 % do not give answer about their knowledge level of VR technology.

65% From the interviewee sample experienced VR Technology in direct military training programmes. 20% of interviewees have experienced VR technology Gaming experience, gaming experience may be in training environment or with any other devices they use in there day to day life. And 10% use VR technology in education purpose and other 5% use VR devices to watch movies and Television.

IV. OPINION ABOUT OBSTACLES TO LACK OF KNOWLEDGE ABOUT VR TECHNOL

Majority of Interviewee’s opinion of obstacles to lack of use and knowledge of using VR technology devices as follows. According to them 41% of Lack of knowledge and user experience in VR devices are a direct impact on the use of VR devices with people. Another reason is Cost of virtual devices. Market price of the devices are bit higher than other devices so 25% have idea that the cost have impact on use of VR devices with in society. When using VR devices, user may have faced discomfort with the devices . Health problems and discomfort of this VR devices are direct impact on the obstacle or may be reason to not use VR devices. 25% have idea that user experience with low quality VR headset , Google or VR cardboard may have direct impact on the user with no longer using this devices or discourage them to use this devices. Other 9% have not indicate any of the above reasons.

B. Quality Attributes analyzing



Figure 6. Quality Attributes Analyzing Chart

The second question part designed to analyse the idea about Differences in mental demand, physical demand, temporal demand, performance, effort and frustration level the interviewee face when they continuing VR and Live training programs. Most of army officers who have at least one VR Based training in Sri Lanka or out of Sri Lanka reported higher perceived mental demand, temporal demand, performance, effort and frustration levels in the virtual world simulation, as compared to the live condition. Results shows that greater physical experience and preference gives by Live Training (65%) rather than Virtual training (35%). Results shows that The environment in the

training simulators makes trainees aware of different dangerous situations increase the temporal mental effort and frustration levels. virtual environment have combat simulators assigned to applications with clear training purpose and combat simulators assigned to different types of training categories. They are rather complex than the live environment. Soldiers perceived higher required mental exertion in this kind of Virtual environment to face different kind of defence situations. They felt more time pressure to take different kind of decisions relevant to the designed virtual environment such as trainings conduct using mission rehearsal exercises systems. There soldiers need more effort with more virtual targets and had higher task frustration in the virtual condition than the live condition.

III. Global Virtual Reality Trends Analysis by Content Analysis

A. 360-degree view goggles

According to the new innovations in Global VR technology Norwegian soldiers given a 360-degree view Virtual-reality goggles and camera systems to "see through" their armoured vehicles with a 360-degree view.(IEEE Spectrum's general)This goggles and camera system provide ability to drivers of trucks and tanks on future battlefields to see all around their vehicles without having to poke their heads out. Virtual-reality headset prototype developed by Oculus Rift used by Norwegian army for the experiment. In this prototype they decided to locate Four spherical cameras on all sides of an armoured vehicle eliminate blind spots by streaming an all-around video view to the VR headset worn by the driver.

Drivers using the headset can even parallel park with the precision of up to a centimetre by looking straight down at the armoured vehicle's treads with high picture quality and its enough to see 10 to 15 metres clearly.

B. Advanced ground vehicle simulators

Advanced ground vehicle simulators Virtual technologies allow soldiers to experience any type of complex platform vehicle with customized vehicle shape and power in a navigate environments native to any part of the world far more immersive and realistic way than using your good old mouse and keyboard or even a driving simulator wheel. It is possible to simulate any vehicle type and develop virtual reality apps for any role one or several soldiers might play in that vehicle (a driver, gunner, hostage, etc.). From light reconnaissance tanks to non-line-of-sight (NLOS) mortars – anything can be modelled down to the smallest details.

C. VR Boot Camp Experience

Most popular and highly influenced military training according to web content is gaming industry. the military

adopt gaming practice a way to train their soldiers, many of which grew up playing video games with entire VR-equipped bases and training facilities have started to use all kinds of devices and VR software including CAVE systems, motion trackers, and real-to-life equipment like vests and guns. Using this kind of gaming techniques soldiers learn techniques and strategies that can be applied in real-life combat scenarios.

D. Medical Training

Practically its very different to train military medical personnel under war-like conditions. But beside from medics play. Most important part in a battlefield. They have to work in stressful and dangerous environments, putting their lives at risk.

Virtual Reality helps to recreate close-to-combat scenarios in virtual reality to simulate life-saving operations. That help to practice various skills under very stressful conditions. United Kingdom researchers and scientists has created such a VR simulation. This VR environment recreates the interior of a Chinook helicopter and lets trainee to immerse into a confined war-zone-like environment of a military evacuation scenario. Then, a trainee is put inside with a prosthetic body on the floor and a VR headset, which lets him immerse into a confined war-zone-like environment of a military evacuation scenario.

IV. CONCLUSION

There must be a long term plan about modern technologies such as VR Technology combined with Information Industry sector and Sri Lanka government to clarify long term objectives and set goals to Sri Lanka army to achieve in coming decade. Militaries those who have experienced Virtual trainings should involve in introducing VR concepts to Sri Lanka to achieve cost effective training methods with our country. There is a huge knowledge gap between the global VR technologies and military training techniques use in Sri Lanka. Defence sector must plan the training sessions into full time courses regarding modern technologies such as Virtual Reality . The training sessions should start from basic technology level and must continue to advance military digital engineering concepts. The trainer resources must be a experts in modern technology with his knowledge and experience. All trainees must conduct effective research or VR prototypes after the training courses which can develop to use in future trainings.

The military's mindset has to be change from being traditional by conducting above mentioned training programmes and awareness programs. Defence sector should explore the possibilities of use of available technologies to combined with VR technologies. Especially

the new resources engaged in military force must have IT and technological knowledge that can be expanded with further, independent technical skills for defence should be developed. There must be sufficient budget allocation for research and development of VR simulators, concept development and resource allocation for training programs. It is ideal to establish a separate establishment within tri forces for VR Technology development handling and should have a separate technology training institute with all modern equipment and facilities to train soldiers on the field with previous knowledge gain in the abroad trainings.

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