Lessons learned from getting loads of people into VR for Collective Training - an overview and analysis of VR for Land Collective Training for the British Army

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Abstract: The British Army Training Capability Branch selected Bohemia Interactive Simulations to conduct a pilot study into the use of Virtual Reality (VR) in Collective Training to explore the strengths, weaknesses, opportunities, threats and benefits of VR technology and its employment. The pilot considered the effectiveness, fidelity, practicality/constraints, architecture, scale, interoperability, infrastructure and mobility of useable VR capabilities. The pilot increased in scale and complexity culminating in 37 players in VR conducting training in a company context in a combined arms battle.

Purpose

BISim led the Virtual Reality in Land Training (VRLT) pilot study so that the following objectives could be explored:

Investigate the strengths, weaknesses, opportunities and threats (SWOT) of Virtual Reality (VR) technology and its application to support British Army Collective Training (CT) focusing on the flexibility and reconfigurability of VR to meet changing demands.

Explore the ability of VR to meet fidelity requirements focusing specifically on limitations in scalability and interoperability and to define a technical architecture and requirements for the future delivery of VR, to help inform future procurement.

Introduction

The investment, pace of technology development and availability of VR has increased dramatically over the last 10 years and has seen VR migrate from the entertainment sector into many other different industries to be used for serious training. Whilst the entertainment value of VR is not doubted (look at sales and the expansion of VR solutions available) the debate of utility of VR for military land training is relatively wide open and there is also a lack of evidence and information on the specific benefits of VR training in the land CT environment. There are however, many examples of the latest VR technology being tested and trialled for military training, predominantly for the air domain but not in a CT land context. To explore this debate, in October 2018 the British Army (Army) launched a competition to find a member of industry to lead the Virtual Reality in Land Training (VRLT) pilot study to take place in Q1 2019. In December 2018, Bohemia Interactive Simulations (UK) Limited (BISim) was awarded the contract to lead the VRLT pilot. The delivery of this pilot study was completed in April 2019 and it concluded with 37 players in VR.

Three Sprints were conducted for the Pilot between January and April 2019 with the aim of each sprint building upon the previous Sprint's results and outcomes. The complexity and scalability were increased between each Sprint with a 'crawl, walk, run' approach taken to the 3 Sprints. Training measurement and evaluation was required during the Sprints to measure against training objectives and Core Competency Objectives. The data was captured from the missions in each sprint and then fed into the Cervus's Hive engine. The players were also monitored by Observer Mentors and questioned on their experiences during the training.

Approach

BISim provided an agile approach to the pilot and developed the concept of 'Innovation as a Service'. This allowed any findings or new opportunities to be explored during the 3 sprints. Throughout all the 3 x 5-day Sprints, a common scenario was used for an Armoured Infantry Platoon, supported by artillery and armour to conduct a number of vignettes. Missions undertaken were; convoy move, advance to contact, rural clearance and clear and defend an urban area.

Sprint 1 - The 'Crawl' Sprint was designed to establish a baseline using the current VBS3 software with no developments and determine the scalability of the network, the performance of the software and the utility of COTS VR headsets, tethered and untethered and targeted fidelity armoured vehicle control grips. This Sprint mainly focused on de-risking the next 2 Sprints, determining how scalable the architecture is and ensuring all parties in the pilot were familiar with their roles.

Sprint 2 - Building on Sprint 1 the 'Walk' Sprint was designed to scale up the training and increase complexity. Briefings were conducted in situ, in VR and avatar customisation was demonstrated. The players also switched roles and played the enemy in VR. Training performance was measured by machine learning using Cervus's Hive engine with a combination of Observer Mentors.

Sprint 3 - The ‘Run’ Sprint was ‘Innovation as a Service’ coming to life. Building on Sprint 2 voice and stress analysis tools were introduced and a 105mm live gun was integrated via Distributed Interactive Simulation (DIS). For the Challenger 2 crew, VR ‘out of the hatch’ was demonstrated. Mixed Reality was introduced for note taking and observing the Battlefield Management System (BMS) and Rehearsal of Concept (ROC) drills were conducted in VR.

Results and Lessons Learned

The analysis and findings are still ongoing but from a BISim perspective several immediate characteristics were observed.

For Sprint 1 a 17-player baseline PC network was deployed in a tank shed using external power, over 85 plug sockets were required to run PCs, monitors and VR headsets. With sufficient power it is believed that with the architecture used and the use of VBS3, it is possible to scale to ~100 players before the frame rate and/or latency would have a detrimental effect on the training experience. During Sprint 1 it was determined that the VBS3 virtual engine was good enough for the pilot and VR. The content was generally good enough and the frame rate satisfactory with minimal fluctuation to cause serious nausea.

The players were immersed in the VR environment for 30-60 mins for each vignette. Whilst some players did experience nausea no one was physically sick. During this Spirit, Warrior crews only had access to 2D, and magnified optics with no 3D interior available for the VR environment which may have contributed to some of the nausea (no relief from immersed, magnified optics). What was apparent is that using VR against a traditional 2D desk-top monitor meant that the players were more immersed and seemed a lot more focused, probably due to the stereoscopic immersion and lack of outside interference or peripheral vision. This was evident by the concentration and the silence during non-challenging aspects of the vignettes and feedback from the players. In VR, the targeted fidelity armoured vehicle control grips could not support the training as the player did not have the spatial awareness to use them.

Building from Sprint 1, Sprint 2 saw the introduction of a high-fidelity 3D model of the Warrior IFV and the architecture increase to 37 players. It was commented by the players that the 3D model made them feel far more immersed and observing the players there was little or no nausea. Complexity was also increased with the additional players, Challenger 2 crew, cloud-in-box enabled Unmanned Aerial Vehicle (UAV) and the Fire Support Team (FST). DIS enabled interoperability between the armour and the cloud enabled a UAV downlink. The off the shelf avatar customisation did bring a degree of more realism, however more development of this capability would be required to provide training benefit.

Sprint 3 witnessed some novel technology to measure performance; voice analysis to evaluate teamwork and infra-red face monitoring to determine how challenged a player is in a situation. This analysis was focused on the commanders and is a way of monitoring reactions under stress and the decisions made. Mixed Reality also meant that the commander had the opportunity to remain in VR and also see the real world BMS by the development of a Render To Texture (RTT) camera feed. A ROC drill in VR brought the ground to life and in the future should enable better situational awareness due to the immersiveness of the game.

What the 3 Sprints demonstrated is that VR can be deployed to the point of need with the ability to inject complexity and new configurations. It is clear that by having appropriate levels of fidelity for the models, it increases immersion and it is our view this should deliver a better training experience and credible training transfer. Deeper immersion should lead to communication and coordination skills under more pressure, resulting in the player being better prepared for live training and operations.

A single unit of the VR set up is approximately £3000 which suggests for a deployable and configurable system it is cost-effective; better than traditional 2D monitors and large metal boxes that are currently in use. There is also a wider utility for VR by using it for briefings, rehearsals and also the in-action and after-action reviews. Extending VR with MR also means that spatial awareness is achieved and real-life objects can be utilised.

Recommendations

VR can be used for Collective Training, it provides a more immersive environment than traditional 2D displays. The immersion should create pressure for teamwork, communication and coordination leading to better trained teams.

Further investigations should be undertaken to determine the physiological impact of being in VR for prolonged periods, for example eye strain.

Targeted grips need more investigating as the current VR and grip off the shelf products, combined, are not user friendly.

Simulation application control schemas need to be completely redesigned from scratch, with a VR specific use-case in mind, to truly replace mouse/keyboard and have natural and fluid control of your virtual avatar in the synthetic environment.

When using VR, a suitable level of fidelity should be identified in terms of how rich the content of the simulation should be in addition to the behaviour of the entities and battlefield effects upon the synthetic environment. This should reduce negative training and boost immersion and training transfer benefits.

MR really adds to the VR experience. Being able to use real world objects and natural actions (e.g. using real world pen and paper on desk) will enhance the training and user experience and negate the need to unnecessarily implement features in VR to compensate (e.g. a virtual pen writing/drawing tool).

As VR simulation evolves it needs to be considered if DIS and HLA enables interoperability or hinders it. Presently these standards were only used for entity and battlefield effect interoperability, but with increasing emphasis on VR for greater fidelity, realism, complexity of the virtual world and how entities react and interact in the synthetic environment these legacy standards 'may' struggle to keep pace. Using open APIs will allow other systems to 'play in the game', maximise innovation, flexibility and exploitation from the far bigger [than Defence] commercial industries who are also investing significantly in VR.

Performance measurement can be a lot more objective due to technology. Non-intrusive performance measurement tools traditional used in other industries should be brought into the collective training environment, i.e. voice analysis and stress analysis using IR.

Conclusions

VR can be utilised in CT and it would require virtual simulation to have better fidelity to realise training benefits. By developing a better simulation capability and exploiting the innovation from the gaming industry new standards or open APIs should be adopted by the military. By deploying VR other briefing procedures can be used over the traditional methods. Architecturally, the hardware can cope with the demands of VR. Performance measurement utilising other industries' tools should be considered for Land training in order to improve training evaluation.

Author and Speaker

David 'Rusty' Orwin was the Project Director for VRLT. Rusty spent 14 years in the British Army in operational and training roles and has worked in the live and virtual simulation domains in industry. He has a BSc in Communications and Media Studies and an MSc in Information Management and Technology.