TRAINING TOMORROW'S LAND SURVEYORS USING VIRTUAL REALITY

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Virtual reality (VR) training has been in use for more than 20 years in various forms. My first contact with VR was in the oil/gas sector in the UK when I was working there for several years. In those days, offshore oil rigs were 3D laser scanned then a 3D model was generated. Animation software was then used with the 3D model to train oil rig workers onshore on where to turn off or on various valves and become familiar with the site before going out to the rig.

The Covid pandemic and the experiences of lockdown have been a catalyst for educators to look at new ways of teaching and learning.

In land surveying the use of remote learning can often be challenging especially in the area of practical field exercises. The outdoor field exercises using levels, total stations, GNSS, drones and 3D laser scanners become challenging. In addition, there is the factor of inclement weather to consider which makes outdoor exercises difficult in some countries with extreme weather like the Middle East, Asia and the US.

To resolve some of these issues, several universities around the world started to develop and implement VR solutions for land surveyors.

Pennsylvania State University (Penn State) in the US started to revolutionise its surveying engineering education through the integration of VR training in 2019. Recognising the potential of VR in enhancing practical skills for an immersive and interactive learning experience, the university's Department of Surveying Engineering embarked on a journey to incorporate VR into its curriculum.

The department, jointly with the computer science department, developed a training module for levelling tailored to the needs of surveying engineering students. They used the Unity 3D gaming engine to build and customise the solution. Part of the campus was 3D scanned from the ground using a terrestrial laser scanner and from the air using a photogrammetry drone. The pointcloud data was then converted to a 3D CAD model and imported into Unity.

Finally, textures were applied within Unity to make the 3D scene more lifelike. Several researchers and developers were engaged fulltime over four months to complete the project and development.

The project focused on two scenarios: three closed-loop benchmark and a point-to-point levelling line. Both scenarios had an achievable accuracy of 1mm if good survey practices were followed.

The solution used VR headsets allowing the students to immerse themselves fully in lifelike environments and interact with virtual objects, enhancing their understanding of the process of levelling.

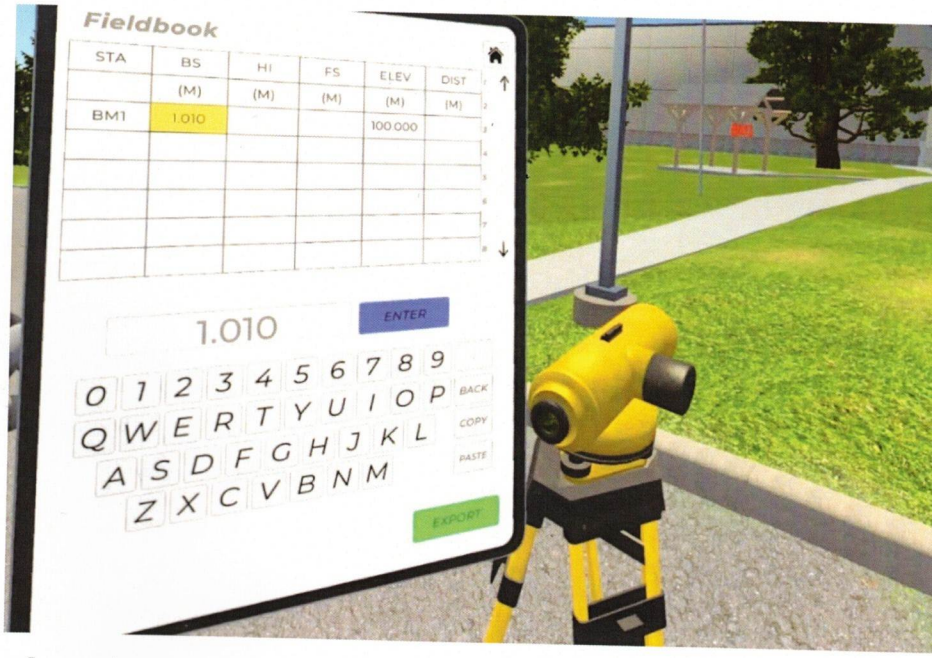
The Hong Kong Polytechnic University in 2023 also embraced VR training as a groundbreaking approach to enhance the education focusing on traversing techniques using total stations.

The traversing VR replicated real-world scenarios, including challenging terrain, varying weather conditions and complex topographies. Students could simulate traversing techniques with utmost realism and interactivity.

VR training provided students with a three-dimensional perspective of surveying landscapes, enabling them to better comprehend spatial relationships and terrain features crucial for traversing.

Virtual environments accurately mimicked real-world conditions, allowing students to practise traversing techniques in diverse scenarios without physical limitations. This realism facilitated practical skill development and confidence building.

VR technology enabled interactive learning experiences, where students could manipulate virtual instruments, take measurements, and adjust surveying parameters in real time, fostering active engagement and skill refinement.



Traversing sometimes involves working in hazardous or inaccessible environments. VR training offered a safe and controlled setting for students to practise without exposure to physical risks, ensuring their safety while honing essential skills.

Traditional field training can incur significant expenses related to equipment, logistics and site access. VR training reduced these costs by providing a scalable and accessible alternative, allowing students to access virtual environments from anywhere at a fraction of the cost.

VR simulations incorporated performance metrics and feedback mechanisms, enabling instructors to assess students' proficiency and provide targeted guidance for improvement, thereby enhancing learning outcomes.

SOUTH has manufactured a range of survey and spatial solutions for the past 35 years and produces a range of products including robotic total stations, GNSS, drones/UAV, 3D laser scanners (SLAM, tripod, drone), marine products and unmanned surface vehicles (USV). Recently it has developed virtual reality training for a range of its products suitable for the educational sector.

SOUTH has recently developed VR training modules for the areas of levelling, total station traverse and drone/UAV. The advantage of the SOUTH solution is that it does not use VR headsets so is more suitable for larger classes of students.

The levelling module is designed for auto level survey training. Fundamental knowledge is acquired through repeated practice in a gaming SIM environment. Features include benchmarks, change points, height difference calculation and checkpoints. All virtual-based staff readings are recorded in the field book of VR programs.

The total station traverse module is designed for total station traverse training.

Fundamental knowledge is acquired through repeated practice in a gaming SIM environment. Features such as line or path of travel, traverse point measurements, open/closed/compound traverse with checkpoints are available. Procedures are reinforced to establish accurate survey control and conduct a topographical survey. The data is exported at the end of the exercise for office processing downstream.

The drone/UAV module is designed for repeated practice of drone operation with no risk of physical crashing. Features include aircraft assembly, drone settings, flight planning, mission control, and ground control points (GCP). All captured images are available to export for office processing.

Conclusion

Virtual reality training is much more than just moving through a 3D scene or digital twin. It's about interacting with equipment and software in a 3D scene, taking measurements, then exporting the data for further office processing – a real-world workflow in a virtual environment.

One issue with the use of VR headsets is the feeling of nausea and disorientation but it varies greatly from student to student. This is a drawback for solutions that use VR headsets and limits the number of students suitable for this technique. Remember the good old days at Otago University with Major Hunt in the photogrammetry lab trying to look in stereo at two sets of images and, unfortunately, there was always a few students who physically could not see in stereo to float the dot over the terrain.

In addition to the use of virtual reality in education, there is the potential to use VR for marketing. For example, engaging with school students at career expos using a VR gaming environment is a great way to connect with this young talent coming through. Career choice for these students is huge and competitive. VR is another tool available to entice these students into the exciting career of land surveying and the spatial industry. These students live and breathe technology so let's speak their language and use virtual reality. ●

There is a common theme in the benefits of using VR training.

Enhanced learning experience: VR training provides students with hands-on experience in a risk-free virtual environment. By practising surveying techniques in diverse landscapes and challenging terrains, students gain confidence and proficiency in their skills.

Increased engagement: Traditional lectures can sometimes fail to fully engage students. However, VR training captivates students' attention through its interactive and immersive nature, fostering active participation and deeper learning.

Improved retention: Studies have shown that experiential learning significantly improves knowledge retention. By actively participating in VR simulations, students retain theoretical concepts more effectively and can apply them in practical scenarios.

Cost savings: Integrating VR training reduces the need for expensive field trips and equipment. Students can access virtual environments from anywhere, eliminating logistical challenges and reducing overall educational costs.

Real-world application: The skills acquired through VR training directly translate to real-world applications. Graduates equipped with VR experience are better prepared to tackle challenges in surveying engineering professions, contributing to their career readiness and employability.