Harnessing technology in pollution response education and training

Pollution from oil spills remains an unfortunate reality of maritime transportation and offshore drilling.

However, technology can play a crucial role in mitigating the environmental impact of these spills and training personnel for quick and effective clean-up. Advanced technologies such as oil spill detection systems, remote sensing, and mapping tools can help quickly identify spills and provide accurate information to responders. Furthermore, training programs that utilise Virtual Reality (VR) and other simulation technologies can help responders prepare for oil spill scenarios and improve their response capabilities. While oil spills may be inevitable, technological advancements can help minimise their impact and ensure a quick and effective response when they occur.

According to ITOPF's data, the number of large oil spills (over 700 tonnes) has fallen over the last few decades. The 1970s, recorded an average of 79 large spills per year, while in the 2010s, the average was only 1.6 per year. This trend can be attributed to several factors, including improvements in tanker design, stricter regulations, and improved response capabilities.

However, it is important to note that smaller spills still often occur and can have significant environmental and economic impacts. The risk of oil spills remains a particular concern in areas with high shipping traffic or where offshore drilling operations are taking place.

Oil spills can cause significant environmental damage, harm wildlife, and impact local communities. Once oil is spilled, it can spread rapidly and can have long-lasting impacts on marine ecosystems, including water contamination, harm to marine life, and damage to coastal habitats. These impacts can lead to severe long-term ecological and economic consequences.

Controlling oil spills can be a challenging and expensive process that can sometimes take years or even decades to complete. In certain cases, it may be impossible for areas to fully recover from a spill. Even once the oil has been contained, the clean-up process can have additional negative impacts on the environment and local communities.

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Serene Ong

Preventing oil spills is crucial and there are several reasons prevention is more cost-effective than response and clean-up. Prevention involves taking proactive measures to eliminate the risk of spills, such as improving safety procedures, implementing stricter regulations, and investing in advanced technologies to detect and prevent spills. These measures can reduce the likelihood and severity of spills, ultimately reducing the economic costs associated with clean-up and recovery efforts.

For the next article in our Technology in Shipping series, the Club has invited International Tanker Owners Pollution Federation (ITOPF), a non-profit organisation that provides technical advice and expertise to assist in the effective response and clean-up of oil spills worldwide, to share more about their Virtual Reality (VR) based training programme.

Background

At ITOPF we provide a wide range of technical services with the collective aim of promoting effective spill response to ship-source spills of pollutants. We're funded primarily by shipowners via their International Group P&I Club insurers and operate on a not-for-profit basis. We provide technical advice (both on-site and remotely) on marine spills of oil, chemicals, and other substances, to reduce impacts on the environment and affected communities.

Alongside this core service, we organise and deliver training courses, workshops and seminars around the world to academic, government, and industry stakeholders in the spill response community. In recent years we have incorporated several interactive training methods and tools to suit a wider variety of learning styles. This includes interactive table-top exercises, gamified learning and new technologies to further enhance the impact of our learning materials. Implementing Virtual Reality (VR) therefore seemed an obvious choice as the next step in developing our training programme.

Why use VR in spill response training?

The technology offers an array of advantages over more traditional learning tools, primarily due to the experiential nature of VR and the sense of immersion it provides. In some instances, workplace scenarios that were previously out of reach due to practical, safety or financial reasons, become instantly accessible by simply wearing a VR headset. As marine spills are infrequent in their nature, there are limited opportunities afforded to spill response professionals to gain experience in certain aspects of their roles. Aerial surveillance following a pollution incident is one such element.

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>
> Miguel Patel

When a spill occurs, gathering information on the location, extent and movement of contamination from an aerial platform enables decision-makers to formulate an effective response. The ability to offer trainees a soft exposure to aerial surveillance in a low-cost, classroom-based setting, where mistakes can be learnt from in the absence of real-world pressures and consequences, is very appealing.

Designing and optimising ITOPF's application

In 2019, our Technical Team undertook a feasibility study to provide a better understanding of VR technology and how it could best serve our training needs. From the outset, a major challenge faced by the project team was striking a balance between the app’s levels of realism and immersion, as well as the practicality and costs associated with development.

An entirely photorealistic experience, for example would be limited to 360-degree video capture and a fixed point of view (known as three degrees of freedom or ‘3DOF’), as opposed to 6DOF which allows a full range of user movement, albeit within a computer-generated environment. Our development team opted for an experience that blended real-world elements with computer-generated 3D effects. This approach allowed for 6DOF and greater immersion for the trainees, as well as the inclusion of real-world footage to ensure an improved sense of realism.

A key design challenge experienced by the development team was perfecting the look and behaviour of spilled oil onto the surface of the sea. References from ITOPF’s photo and video library were provided to the 3D Artist, who developed a novel system of layering and synchronising oil movements with those of the sea.

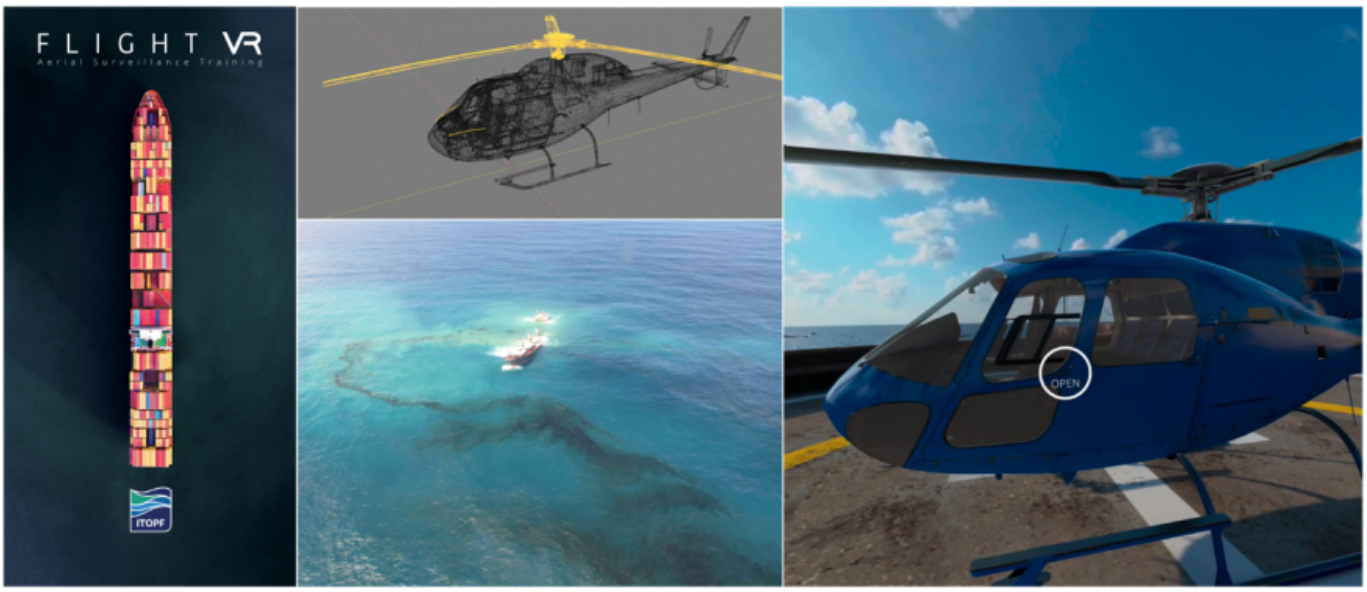

Figure 1. 3D model design and references used in the early stages of development (left); Screenshot of the final experience which combines real-world environments with computer generated 3D models (right).

We typically conduct our face-to-face training workshops in-country, with events usually consisting of 20-50 attendees. VR systems requiring external graphics processing (via a dedicated gaming PC) offer optimum performance but would be costly and impractical to transport internationally. Such systems would also limit the ability to run several headsets simultaneously, which would prevent all attendees from participating in the VR experience. As a result, we opted for a compact standalone platform, the Oculus Quest 2, which provided the perfect compromise between performance and practicality.

The roll-out of ITOPF's Flight VR app and future outlook

Since its launch at ITOPF's Interactive Lunch and Learn event at London International Shipping week in September 2021, the reaction to our Flight VR app has been overwhelmingly positive. The app has since been integrated into an interactive table-top exercise, designed to simulate numerous aspects of pollution response, providing an ideal platform for experiential learning at ITOPF's training workshops.

The VR experience lasts approximately 10 minutes and puts the user through a series of tasks covering aircraft selection, the observation of false positives and data capture. An app-generated aerial surveillance report serves as the basis for subsequent decision-making within the simulated exercise scenario. Participants at various ITOPF-led workshops have highlighted the VR experience as among the most memorable aspects of our training.

Figure 2. ITOPF demonstrating Flight VR at various events in 2021 and 2022.

Working with VR and understanding the limitations and the capabilities of the software has been a transformative experience for both our training coordination team and the trainees. The overwhelmingly positive feedback from spill responders, demonstrates the platforms effectiveness in providing a realistic simulation of the challenges faced when conducting aerial surveillance in a real-world scenario.

Considering this feedback, we are encouraged to pursue further development of our VR app, as well as keeping a close eye on emerging Augmented Reality (AR) and Mixed Reality (MR) technology, as we seek to improve our training and education service.