White Paper:

Effective Fireground Training During COVID-19 Related Emergency Declarations

Another reason to look into Virtual Reality training

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How We Train in the Fire Service

Fire service tactical skills training breaks down into three basic categories: online, classroom, and fireground. Online has been useful for NIMS, annual RTK-BBP, and other standardized training. Classroom training, with technological advances, has progressed from straight lectures with study materials to animated and video simulated fireground training. Then there's fireground training generally, and live-fire training specifically. Live-fire training, historically, has been the gold standard. Its where we feel our firefighters get the most realistic experience and can get as close as possible to low frequency / high-risk situations.

What, though, are the economic, environmental, and human costs we endure to provide such training? Let's look at each one.

Economic Cost

- Operation of apparatus and support vehicles
- Operation of equipment
- Construction and maintenance costs for burn structures
- Use of facilities, materials, and qualified trainers
- Compliance with state law or NFPA 1403, Standard on Live Fire Training Operations
- Legal liability

Environmental Cost

- Apparatus, generator, and mechanized equipment exhaust
- Water discharge
- Foam discharge
- Wastewater runoff from repetitive and extended live-fire training operations
- Air pollution caused by setting materials to burn.

Focusing on the human cost, whenever a firefighter, especially an inexperienced one, dons full PPE and goes out for a training evolution, the risk of injury or death stares us in the face. That risk is real and perhaps is the most senseless and preventable. According to NFPA annual tracking, in 2018, there were over 8,000 training injuries (14.0% of all firefighter injuries), and eleven training deaths (17.2% of all firefighter deaths).

As firefighters, we accept the dangers of our profession, doing whatever we can to minimize risk. Still, we didn't sign up to become permanently disabled or die in training. Speaking from a fire chief perspective , why would you want to live with the knowledge a firefighter was permanently injured or killed in training for which I was responsible?

On top of all this, now most training is postponed due to the Coronavirus/COVID-19 pandemic. So, how about considering the use of VR as a complement to live-fire training, applying some continuous improvement principals?

Human Cost

- Exposure to carcinogens, pollutants, and contaminants
- Risk of firefighter serious injury
- Risk of firefighter death

What is Virtual Reality?

As defined by The Virtual Reality Society, Virtual Reality (VR) describes a three-dimensional, computer-generated environment that can be explored and interacted with by a person. That person becomes part of this virtual world or is immersed in this environment. While there, they can manipulate objects or perform a series of actions.

Applied to fire service training, VR uniquely places firefighters in a multitude of scenarios. In all of these scenarios, VR breaks down response, arrival, size-up, search and rescue, and suppression activities. Firefighters learn and put their skills to the test and build on those skills in a safe environment.

Advantages of VR Training

The positive impact on economic, environmental, and human costs is so comprehensive that it becomes self-evident how important this technology is to the fire service. Apparatus and fuel-powered equipment isn't used, providing economic and environmental savings. Water doesn't flow, materials aren't burned, pollutants aren't breathed or absorbed, and PPE doesn't have to be washed. Finally, and most importantly, VR minimizes the risk of serious injury or death.

In addition to the above, VR is a cost-effective alternative to live-fire training. It provides a wide range and choice of scenarios, creates a highly engaging training environment, and a method for data collection, allowing for adaptive learning in the VR environment. Engelbrecht, Hendrick, "A SWOT Analysis of the Field of Virtual Reality for Firefighter Training," Frontiers in Robotics and AI Vol. 6 (2019): 101, https://www.frontiersin.org/article/10.3389/frobt.2019.00101.

One additional benefit is the potential impact on recruitment and retention. VR gives applicants as realistic an introduction as possible to the world of firefighting. Currently, we perform psychological and physical tests and background checks. Maybe provide some introductory films designed to scare applicants or, at least, give them some familiarity with the world they wish to enter. Imagine, though, being able to provide applicants a method that virtually puts them in the scene. Not just by watching another firefighter with a Go-Pro on their helmet, but by immersing them in that burning structure or wildfire. The impact on retention will be worth measuring as VR becomes more prevalent.

The Range of VR Options

The VR experience spans a broad spectrum in terms of experience, functionality, and cost. These options include:

- Firefighters use an app to access different fire scenarios in which they can participate, using a viewer into which their mobile device fits.
- Use a VR headset designed for use alone or together in a training group, which can be held online and using apps or training programs with more immersive technology.
- Use of a fully immersive VR ensemble with helmet, turnout gear, headset, and nozzle. This ensemble allows the user to experience heat, water pressure, breathing apparatus, and even smell while placed into countless structural, wildfire, hazmat, search and rescue, and other scenarios.

How Virtual Reality Compliments Live-Fire Training

Virtual Reality means to complement, rather than replace, live-fire training. VR is still limited in the experience it provides. Indeed, the current limitations of VR are well documented and include:

- Developing technology that more accurately demands, tests, and measures physical and psychological response to scenarios.
- Acceptance of new technology
- Creation of team capability. Currently, the technology puts the firefighter into the scenario alone, rather than with another firefighter or a crew, which is the way we work. Engelbrecht, Hendrick, "A SWOT Analysis of the Field of Virtual Reality for Firefighter Training," Frontiers in Robotics and AI Vol. 6 (2019): 101, https://www.frontiersin.org/article/10.3389/frobt.2019.00101.

Accepting these current limitations, the complementary nature of VR, rather than arguing for it as a replacement, becomes apparent. Let's look at the three different styles of immersive learning technologies that can be applied to fire training objectives.

A. Example of a cardboard VR viewer using smartphone device

B. Example of using a standalone classroom in a box VR headsets (RiVR Link used by a group of students (Cosumnes FD, CA)

C. Example of using "full gear" VR ensemble (FLAIM System demonstrated at CTIF conference)


A


B


C

Types of Content That Can Be Consumed in a Virtual Reality Headset

1. Computer Generated Imagery (CGI) is the creation of animated visual content with imaging software. CGI is very modular, scalable, and deployable. Examples of CGI applied to firefighter training include:
   a. Firefighting and hose skill training. Training tools use haptic (i.e., uses the sense of touch) hose reel, SCBA, and heat vest that all add more levels of realism. Similar technology is used for fire extinguisher training. Example: FLAIM Trainer and Extinguisher
   b. Emergency driving simulation. Examples: L3, FAAC and ADMS
   c. Equipment training including pump panel operations and hazmat measurement equipment (for example FAAC and XVR)
   d. Fire investigation and crime scene forensics using photorealistic CGI. Example: RiVR Investigate
   e. Decision making on fire ground, hazmat scenes and other emergency situations. Examples: PIXO and XVR Simulation platforms
2. Three hundred sixty-degree video films in real life replayed back to the viewer via a VR headset. The content is consumed passively and allows for intuitive classroom learning. Content can be created and packaged by the seller, or buyers can be taught how to create content. This content can be highly customized to meet the needs of the department's learning objectives. An Example is the RiVR Link "Classroom in a box" solution which connects up to 50 headsets at the same time to enable a scalable and tangible learning experience.
3. Three hundred sixty-degree video or (CGI generated video) scenarios with interactive multiple choice questions allow the viewer to take decision and see the consequences of decisions. The interactive scenarios can be accessed online using the viewers or headsets described earlier. Examples of interactive 360 solutions include: WarpVR and XVR360.

Conclusion

Fire Departments are successfully adopting VR training. "Virtual Reality Preps CA Firefighters for the Real Thing," Firehouse (December 15, 2019): https://www.firehouse.com/tech-comm/video/21118218/virtual-reality-googles-prepare-ca-firefighters-for-the-real-thing. Additionally, states, such as Kentucky have approved Firefighter VR Training.

Virtual Reality, as a training tool in the fire service, with its acknowledged strengths and constant improvement of its weaknesses, is already a part of the training toolbox. The reduction in the economic, environmental, and human costs, along with the tangible benefits of VR training, is too significant to ignore. Add in today's environment where social distancing is becoming the new normal, and it becomes clear that Fire agencies must consider Virtual Reality training.

Additional Resources

Fire Departments successfully adopting VR training. "Virtual Reality Preps CA Firefighters for the Real Thing," Firehouse (December 15, 2019): https://www.firehouse.com/tech-comm/video/21118218/virtual-reality-googles-prepare-ca-firefighters-for-the-real-thing

Kentucky approves Virtual Firefighter Training. https://www.wtvq.com/2020/04/09/firefighters-approved-virtual-training/