Virtual Reality as a Tool for Assuring Code Compliance in Facility Design and Construction

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1. Introduction

Virtual Reality (VR) technology has progressed over the last 40 years from its early inception as panoramic view presentation and "the ultimate display" to three-dimensional manufacturing modeling, complete with tactile control and shape and texture modeling using "datagloves". Applications have been numerous, from motion picture production and selection of vacation resort destinations on the family computer, to manufactured part modeling for product demonstration and sales. As VR technology progresses, VR will create new social benefits and public enhancements to quality of life and public safety.

VR models have stepped beyond the realm of providing the personal computer user a 360-degree panorama view of a hotel room to now presenting complete "virtual tours". Indeed, today's pc-user now has the capability of walking into a building and strolling down the hall to a room and looking around from any point in that room. VR is thus a terrific tool for "selling" facilities to potential customers or clients. However, VR can be used even more as a tool in facility design and the presentation of that design to civic code enforcers for review and approval of the facility's plans before any expenditure is made on its construction. VR demonstration to clients and code authorities, such as city or state fire marshals can assure that necessary building features, such as fire alarm devices, are adequately incorporated into the building design before construction. This can save the building owner the expense of costly change orders and construction delays that may be incurred upon the rejection and citation of the facility by a disagreeable "Authority Having Jurisdiction" (AHJ). VR has its roots in novelty, sales and entertainment, but it can serve "the greater good" as a tool to promote safe and economical building design and construction that is done right the first time.

The objective of this project is to present VR as a tool for assuring code compliance in facility design and construction. As an example case study, an office suite is toured in VR, where life safety devices such as fire alarm horn/strobes and lighted exit signs can be located and tested, and building egress pathways can be presented to the design and/or enforcement authority for approval prior to construction. This project focuses on VR as a design tool for assuring that the facility is safe and built in a code-compliant manner from the moment of the first scoop of dirt is turned to the time that it is turned over to the owner and the public "for the greater good".

2. Experiment, Results, Discussion and Significance

This project employs a VR tour of a suite of offices in a speech and hearing clinic at Wichita State University. Originally, this software was designed to be shown to new clinic employees and patients to demonstrate escape routes in case of fire. In fact, interactive features allow a fire to be started in a trash can, which itself activates the building fire alarm system and guides the user to a building exit and safety outside the building. This project now attempts to take this software a few steps further, in making it an interactive VR design tool, which will allow the

user to tour the facility and actually point out and record locations where fire alarm enunciator devices (horn/strobe equipment), exit lights or emergency lights need to be added to facility walls and/or ceilings. With this enhanced feature, the VR tour now becomes a VR facility inspection.

Given the original intent and ability of the VR tour software, the first logical step for the use of interactive VR inspection capabilities is the submittal of this tour to code authorities such as state and local fire marshals that have jurisdictional authority allowing for building occupancy after construction is complete. To the building designer, the value of such a model is readily apparent. The question that remains is whether or not code officials can make use of the model to pre-inspect the building design and record their findings within the course of the virtual inspection. If so, building costs can be limited, as expensive modifications made necessary by code official findings upon post-construction inspections can be averted by the discovery of design omissions made by authorities that take a pre-construction VR tour.

This project has developed a sample VR tour for dispersement to area and state fire code officials. Upon use of the tour, these officials are being surveyed to gauge their response to the design technology and their impressions of its effectiveness as a pre-construction inspection tool. The survey aims to assess whether or not the tour adequately empowers them with design input that will make their post-construction inspections more efficient, less problematic and, most importantly, less costly for the building designer, contractor and owner. The bottom line basis for the VR model is its use as a tool that will reduce or eliminate the cost of post-construction add-ons of alarm devices after final fire marshal inspections. If fire code officials are satisfied with this VR inspection capability, they will most likely be satisfied with the building's design and its construction, which will ultimately be more cost-efficient with this employment of VR technology.

3. Conclusions

Although this software is developed from an existing facility, it demonstrates that similar models can be built from plans for proposed buildings. Building architects and engineers, with this type of tool in hand, can then be empowered with the ability to inspect a completed facility for design adequacy before a brick is bought or a shovel-full of dirt is turned. Early returns of surveys are indeed showing a positive response by fire code authorities and building design professionals in their assessment of VR technology as a design and facility inspection tool. Costs associated with VR technology are already trending downward as the technology evolves, so with ever-escalating building costs, the avoidance of construction change orders in response to post-construction inspection findings validate the expanded use of Virtual reality technology in building design and pre-construction inspection by building professionals and code officials.

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