
Virtual Reality for Planning, Design, and Construction in Roadway Engineering

Yousef Dana

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Illinois Asphalt and Pavement Association

University of Illinois at Chicago

This research paper explores into the application of virtual reality in civil engineering, including the plan production and construction of projects. Once limited to the video game industry, Virtual Reality is quickly making its way into design and construction. Construction is one of the least automated industries in the world today, but the application of virtual reality can change that. We can see other industries thriving with the use of modeling and virtual reality, such as Architectural firms. I learned the true potential of this technology during my capstone project when I presented a fully modeled version of our project site in virtual reality. Through my research, I spoke with professionals from the consulting, contracting and construction fields in their opinion on the use of this technology and its benefits and disadvantages. VR not only aims to create an interactive environment for the contractor but also allows users to display useful information of the site.

Virtual Reality is defined as a computer-generated scenario that simulates a realistic experience. Users can put on a set of goggles to display a virtual environment to stand and walk in. Ideally Architectural Visualization is a rapidly growing industry where builders, architects and interior designs present sophisticated 3D renderings to clients before the building is sold. The field is exponentially getting more popular because an image can explain a design better than words. I believe that civil engineers can use the same technology to not only display the project to the client but also during the construction phase of the project.

A group of four students and I worked on a capstone project for our senior design course. One of the most important aspects of this project was the ability to present our project to a group of professional project engineers and managers. Explain the layout, feasibility, and construction phases needed to complete this project. I developed a virtual model of our site to be displayed in a virtual reality headset for the judges to use during our presentation. This opened up a world of more information for the judges to accurately see what we are presenting. Each judge had the ability to point and ask about any piece of infrastructure within the 3D space, without being on the actual site. The team's project advisor, Professor Joseph Schulenberg of the University of Illinois at Chicago stated, "I feel that the use of virtual reality could very well become a new standard in communicating complex projects to clients and stakeholders." after seeing the potential it had in our presentation. Our team won second place overall and a Globe Award in the Infrastructure Improvement category due to our innovative design and presentation. The expo was made up of 130 projects, which were presented by more than 500 students competing in five categories.

After winning such of an achievement for my senior design project, I was interested in the real world use of virtual reality. I researched the professional opinions on virtual reality in construction. I interviewed project engineers at Clark Engineering, Milhouse Engineering and Construction and professors at the University of Illinois at Chicago. The application of virtual reality can be an easy transition from the existing BIM modelling software development that is out on the field. The two ways I learned from professionals on how this technology can be used is assisting field coordination and safety training.

Virtual Reality models can be used to avoid field coordination issues by designing a model that matches architectural and civil drawings. The more information you can provide the contractor and construction worker, the better and quicker the job will be completed. Visualizing the exact phases of a construction would be extremely useful for field engineers to determine faults before construction happens. Displaying information of the different materials and properties for the construction worker just like BIM modelling. A model of the site in a VR simulation could also show the site's progress at any given date to keep clients and civilians informed without risking safety.

In the field of construction and construction engineering, safety is an age-old problem but one of the biggest concerns. Through years of OSHA training and other safety training sessions, we can still see accidents prevalent in the industry. Safety training using Virtual Reality is another use of the technology that could possibly prevent numerous amounts of human tragedies. To design a simulated construction site and display it in virtual reality could open doors for the safety training aspects of construction. A virtual construction site would be a safe way to understand what happens on site. Contractors could train the trainee on how to use equipment and where to use safety precautions without having the trainee on the physical site.

Virtual Reality is the future of civil engineering and construction. This technology has shown its potential in the architectural industry and recently showed its power through my capstone project. It has the ability to display much more information without having to physically be on a site. Throughout my research I have interviewed several professionals on the practical application of this technology in the field. The two largest selling points were to assist in field coordination and safety training. This technology has a lot of potential and it will be adapted into the construction field very soon.