

Computerized Accident Reconstruction and Training for Metal/Non-Metal Mines

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KEY WORDS: computer visualization; safety training; simulation; virtual reality; occupational health and safety; work environment

BACKGROUND

A NIOSH study on occupational deaths between 1980 and 1989 indicated that the mining industry has the highest average annual fatality rate (31.9 per 100,000 workers). Mining is also the highest risk industry in 23 states, and accounts for the largest number of occupational deaths in three states [MMWR, 1994]. Researchers believe that the use of enhanced computer visualization and multimedia training tools will help to reduce these injury and fatality numbers. Accordingly, researchers at the Spokane Research Laboratory (SRL) are developing computer programs that will be used to educate mine workers on the hazards of mining, as well as train miners in evacuation routes and evacuation procedures.

Computer-based training tools offer several distinct advantages over more conventional training tools. Computer-based tools provide a three-dimensional immersive environment that allows the trainee to experience mining hazards and view mine accidents without actually being exposed to mine hazards. This "time-on-task" will help reinforce the learning acquired during more conventional classroom instruction. In addition, the inherent flexibility of this type of tool allows the training material to be tailored to meet the requirements of individual mines.

METHODS

Researchers have divided this project into two distinct tasks: (1) accident reconstruction and (2) mine evacuation

and hazard recognition training. The goal of the accident reconstruction task is to develop simple, cost-effective computer visualization tools to be used to reconstruct accidents at mine sites. These reconstructions are generated using off-the-shelf computer software and three-dimensional computer models created at SRL. The reconstructions can then be used to train miners to recognize and avoid particular hazards associated with their jobs. For example, researchers have reconstructed a haulage accident that resulted in a fatality at a surface mine. The accident occurred when a worker stepped behind one dump truck in order to direct a second dump truck (Fig. 1). The first truck then backed over the worker, killing him instantly. Researchers believe by viewing these types of reconstructions, mine workers will be more keenly aware of the hazards at their site and, therefore, would be more likely to avoid such hazards.

The goal of the mine evacuation and hazard recognition training task is to develop cost-effective and flexible virtual mine environments that will be used to train underground mine workers and rescue personnel in evacuation procedures and hazard recognition. For evacuation training, the trainee would be able to practice escape routes in a three-dimensional and immersive computer model of the mine in a disaster situation, complete with smoke, fire, and other dangers. Several trainees can participate in the same simulation, allowing teamwork to be evaluated. The simulation could be practiced numerous times, allowing the trainee to become familiar with procedures and evacuation routes particular to that mine.

These virtual mines can also be used to train mine workers in hazard recognition and hazard avoidance. The virtual mine may include such hazards as unsupported roof or falling or electrical cables. The trainee can then be taught to recognize and avoid the hazards without actually exposing the trainee to a "real" hazard.

Researchers at SRL are using three-dimensional gaming engine software to create "mine evacuation and

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Accepted 1 May 1999



FIGURE 1. Computer generated animations are used to accurately reconstruct surface haulage accidents.

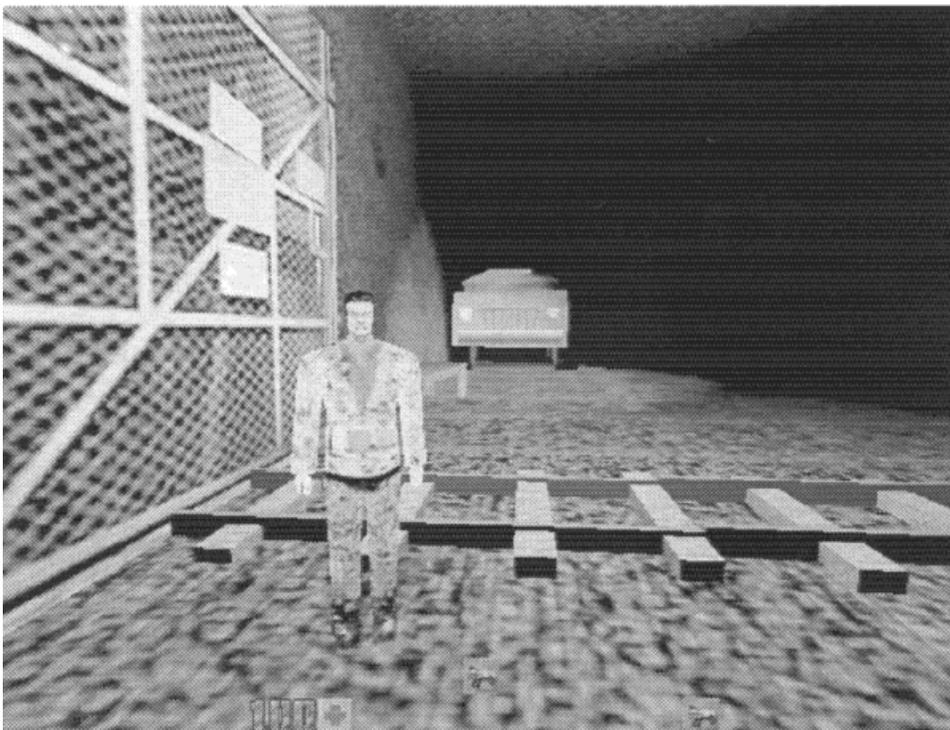


FIGURE 2. Virtual mine environments such as this one are used to train miners in hazard recognition and mine evacuation procedures.

hazard recognition training simulator”. This technology allows the rapid and affordable creation of virtual mine environments that can be accessed using conventional personal computers. In addition, the networking features of this technology allows several trainees to work together within the same virtual mine environment (Fig. 2).

RESULTS

Researchers at SRL have created one mine fatality reconstruction based upon a Mine Safety and Health Administration (MSHA) fatality report. Researchers have also created three-dimensional computer models of several

pieces of heavy mine equipment. These models will be used for future accident reconstructions.

Several different generic mine evacuation and hazard recognition training modules have been completed. These modules provide a basic mine evacuation scenario along with several hazards that must be identified and avoided by the trainee. These hazards include falling hazards, electrical hazards, bad air hazards, and a roof fall hazard.

The accident reconstruction and the mine evacuation and hazard recognition training modules have been demonstrated to mining professionals. Informal feedback indicates that the mining industry is supportive of the use of this type of technology as a training tool. However, further objective tests are being planned to assess the effectiveness of computer-based training materials for the mining industry.

CONCLUSIONS

Preliminary research indicates that interactive, computer-based tools can provide effective safety training for mine workers. These tools can be tailored to meet the needs of individual mines while remaining cost effective and relatively easy to use. The mining industry has shown initial support for this type of technology as a safety training tool. Further objective testing is required before the effectiveness of these tools can be fully assessed.

REFERENCE

MMWR. 1994. Occupational injury deaths—United States, 1980–1989: Morbidity and Mortality Weekly Report 43:14.