Application of virtual reality technologies to the simulation of Coal Miners' Safety Behaviors

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Abstract*—This article establishes mine workers' safety behaviors simulation system through combines virtual reality and mining safety production. The aim is to standardize safety behavior, improve the effectiveness of safety training and accordingly reduce the accidents' occurrence in coal mine. The system is constructed by means of 3D building software. Then, an integrated development in the platform Virtools is done. Through the computer software and hardware equipment, the three-dimensional (3D) space including various natural entities and artificial entities of coal mine are simulated based coal mining stratum datum, tunnel datum and images, which enable workers to interact naturally with hypothesized entities. Besides, the system can simulate mine shaft environment, workers' behaviors, and some accidents scene ambience (such as detonation, fire, smog and so on). With writings, sound explanation and background sound effect matched, the emulation effect is very good. Therefore, there is no doubt that the use of VR can make mine workers familiar with mine shaft environment, recognize dangerous sources, and standardize safety behaviors, and finally make behavior specification realized. The system first carries out the simulation of workers' safety behaviors in coal mine production environment and has important application values.*

The safety problem in human production activity gets more and more attention along with the society unceasing development, and also the safety investments increase gradually. But throughout our country coal mine safety condition in recent years, the quantity of accidents is still very huge. How to control the accidents' occurrence effectively is an important issue for safety managers. In the production process of the coal enterprise, there are mainly two factors that cause the accident to happen, one is the unsafe state of thing (production environment), another is the unsafe behavior of human (workers). The state of the thing is passive while human's behavior is initiative, and the state of thing is determinated by human's behavior directly. Therefore, in order to realize the humanist safety management, it is necessary to adopt the effective measures to specify the workers' behavior. Combining the technology of hypothesized realization with safety production in coal mine, the paper establishes the coal workers' safety behavior simulation system which offers a very good attempt for our country coal informationization construction. Through the computer software and hardware equipment and according to coal mine stratum data, tunnel data and images, the three-dimensional (3D) space including each kind of natural entity and artificial entity in coal mine is simulated. In the 3D space, the worker can interact with each kind of hypothesized entity. By this operation of 3D visualization, the worker is familiar with mine shaft environment, understand dangerous source and grasp the safety behavior, and finally realize behavior specification. Just because of the visualization, immersion and reality of the operation, this system achieves the goal to specify the worker behavior.

First the present development situation of hypothesized realization technology widely applied to military, astronautics, architecture, medical service, entertainment and other fields is studied, as well as the present utilization situation of coal mine. Then by the analysis on accident-causing theory, it proposes that coal mine workers' safety behavior simulation software can be applied in order to reduce the accidents' occurrence in coal mine. The paper also proves the goal and significance to explore simulation system, and the design proposal to build model with 3D software then to carry on the conformity on the developing platform Virtools. The system can simulate mine shaft environment, worker behavior, and some accidents' scene effect (such as detonation,

fire, smog and so on). With writing, sound explanation and background sound effect matched, it can realize very good simulation effect. Finally the paper points out system development part needed to improve and the perspective of system utilization.

Key word: *Virtual reality, Virtools, simulation of safety behavior, behavior specification, coal mine.*

Author intrduction:

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