2.3.2 *Proximity selection*

One of the major challenges facing mine safety trainers is conveying the importance of performing the actual inspection to new employees. All to often, vehicle operators perform cursory inspections and overlook important details that can be identified only by close examination. To help better train vehicle inspectors, proximity selection is being added to MVIS. In the current version of MVIS, objects can be inspected from any distance in the VR world. A bed pin on haul truck could conceivably be inspected from three miles away (provided the user can choose the part with the mouse). Proximity selection is a way to enforce maximum distances between the user and the part before a part can be selected. In the bed pin example, the MVIS administrator could enforce the policy that inspectors must be within three feet of a bed pin before it can be inspected. The distance from which a part can be selected will be defined in an inspection scenario definition on a part-by-part basis.

2.3.3 *Inspection order*

Most mining companies design their own process for performing the pre-operational vehicle inspections. It is the goal of MVIS to accommodate as well as complement the various ways to perform inspections and to aid trainers in teaching the process of inspections. A soon-to-be-added feature of MVIS is the ability to enforce the order in which groups of parts are inspected. For example, a mine might require that the front left wheel assembly (strut, steering linkage, wheel, tire, etc.) be inspected before all other parts. However, according to mining professionals, it is inconsequential in what order the parts within a group are inspected. The inspection order allows a training administrator to define groups of parts, as well as an order in which the groups are inspected. The unique aspect of this feature is that parts within a group can be inspected in any order, while group inspection order is enforced. Inspection of a group is not complete until all parts in that group have been inspected. This feature will be controlled from within the inspection scenario definition.

2.3.4 *Model and scenario customization*

Although model data files used by MVIS are standardized, the composition of the model data within the file is highly proprietary to MVIS. Therefore, we are currently designing a software tool that will allow mine companies to convert existing CAD/CAM models of vehicles and equipment (including defective parts) to the format supported by MVIS. This package will allow a scene designer to decompose a vehicle into inspectable parts and non-inspectable parts for use with MVIS and to identify where defective parts will be included in the model. This package will also be capable of designing and storing the scenario definition file for a specific model.

2.3.5 *Enhanced inspection dialog box*

One of the major challenges of providing a realistic inspection experience in VR is the representation of highly accurate models of vehicles. It is difficult to obtain computer models of vehicles that have the kind of detail needed for performing a thorough inspection. These models are usually guarded secrets of the vehicle manufacturer. Furthermore, even if one of these models was available, the sheer complexity of the model would be beyond the capabilities of modern PC hardware to render in real time for VR. For these reasons, we are going to add a detail view to the inspection dialog box. The detail view is a subsection of the inspection dialog box that displays an actual picture of the part being inspected. This feature will help eliminate the need to have extremely detailed models of vehicles while still demonstrating to the trainee exactly what should be examined.

3 DRIVING SIMULATOR

The second aspect of mine safety training being investigated at the University of Nevada is driver training. The United States Occupational Safety and Health Administration (OSHA) stated in 1995 that industrial trucks accidents are the second leading cause of fatalities in the private sector [5]. On average, there are 107 fatalities involving industrial trucks per year. The Mine Safety and Health Administration (MSHA) reports that over the last few years accidents involving operators of off-highway haulage vehicles in surface ground mining operations have resulted in between 15 and 20 fatalities per year and between 350 and 450 near fatalities per year [4].

Our team has developed a prototype simulator to assist in driver training appropriate to the surface mining industry. Our prototype package, the Mine Vehicle Driving Simulator (MVDS), is an attempt to determine the requirements of such a simulator with respect to technological challenges of software development and customer requirements. The prototype development of MVDS focused on two key areas: driving simulation and pit hazard simulation. MVDS is designed to train drivers on the skills necessary to safely operate power haulage in an open pit surface mine. MVDS accomplishes this by simulating vehicle operation in an open pit mine.

3.1 *Product Overview*

When a person begins their driver training with MVDS, they are seated in front of a computer screen on a desk with a steering device. MVDS uses a consumer grade steering device with a steering wheel, simple gear shift, and gas and brake pedals. On the screen, the trainee is presented with a 3D model of what they would see out of the front windshield of their vehicle when driving in a mine, as shown in Figure 5. MVDS can convert files containing mine layout data produced by mine software to a format it can use. This allows the trainee to view the pit in which they will be driving.

The trainee is to drive around the mine (possibly fulfilling some task) while observing the "rules of the road." These rules for mine vehicle operators differ considerably from Department of Motor Vehicle regulations for highway vehicles. For example, in most mines, operators are required to drive on the left rather

Figure 5: Screen Shot of MVDS Prototype.