Using Second Life to Demonstrate a Concept Automobile Heads Up Display (A-HUD)

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ABSTRACT
There are different options to establish and test new technology within automobiles. From simulators to real world driving, most have disadvantages of development time, expensive costs, or complex setups. We describe a method using Second Life’s virtual world to conduct simulations for driving and testing a new conceptual Automobile Heads Up Display (A-HUD).

Categories and Subject Descriptors
H.5.1 [Information Interfaces and Representation]: Multimedia Information Systems – Artificial, augmented, and virtual realities

General Terms
Design, Human Factors.

Keywords
Driving simulator; mobile broadband; heads up display; augmented reality; automobile technology.

1. INTRODUCTION
The Automobile Heads Up Display (A-HUD) was initially developed in a position paper that describes a method of immersing a driver inside an additional layer of traffic and navigation data, and presenting that data to the driver by embedding display systems into the automobile windows and mirrors [1]. In brief, through gaze tracking, the digital information is superimposed and registered with real world entities such as street signs and traffic intersections. A-HUD utilizes both high-speed mobile broadband and augmented reality technologies to support car drivers through controlled information distribution.

One storyboard scenario is driving to a location for the first time. “Jane” will need to travel along suburban roads, city streets, and a major freeway to reach her destination. Jane’s GPS system has already plotted a path, so an illuminated directional arrow appears in the car’s HUD. As Jane enters freeway, an accident has just occurred ahead, blocking off all but one lane and slowing traffic down. Almost instantaneously, new information appears in the car’s HUD. The estimated time under the original arrow (which is pointing straight ahead along the freeway) blinks rapidly in red and now reads “110 minutes.” A second arrow has also appeared; this new arrow is pointing away from the freeway, toward the next exit. Underneath the new arrow is another time estimate, reading “72 minutes.” Jane follows the new arrow to exit; the arrow continues updating new artifacts to show the path that Jane needs to follow to reach her destination.

Figure 1: A mockup from the A-HUD storyboard. The driver is looking straight ahead and seeing augmented navigation directions based on traffic.

Studies have shown that HUDs increase driver performance [2]. After developing the A-HUD concept, our next step was to select an environment by which we could test and evaluate A-HUD. Several options were considered as possibilities, but most were eventually rejected. Developing our own simulator would give us freedom of customization and control, but can take considerable amounts of programming time. Using existing automobile simulators offered the most realism, but was impractical given the complexities to setup, and the A-HUD had not reached an advanced level of development. Customizing a real car was neither practical nor cost-effective.
2. SECOND LIFE
As described by its website, “Second Life is a 3-D virtual world entirely created by its Residents. Since opening to the public in 2003, it has grown explosively and today is inhabited by millions of Residents from around the globe.” The world inside Second Life attempts to mimic many real world properties. For example, it has gravity, physical contact between users and/or artifacts produce the expected collisions, etc. Second Life’s physics are generally realistic and the environment simulates many properties of the real world.

Various organizations have begun utilizing Second Life for business, educational, or other specific purposes. Educators and researchers alike have taken advantage of the opportunities Second Life provides to study different forms of social interaction in a virtual environment. Medical education, business, online learning, and many other fields have used Second Life to conduct their research.

Second Life users can employ a combination of GUI tools and a scripting language to create objects in the virtual world. The GUI tools enable users to create primitive objects (called prims), and then alter their shape, size, color, and other properties. Prims can be joined together to build more complicated objects. Users can then create scripts using the Linden Scripting Language (LSL). LSL is built for use exclusively inside the virtual world. Users can create highly complex scripts and attach them to prims, making them behave in many different ways.

Vehicles are not necessary to traverse through Second Life, as walking and flying are just as, and sometimes more, effective. Instead, vehicles are usually designed for recreation and entertainment. Anyone can create vehicles in Second Life to their own specifications. LSL provides a set of functions to help Second Life users design unique vehicles.

3. SECOND LIFE AS A SIMULATOR
We determined that the Second Life environment offered the most practical and effective solution. With many real world physical properties, we could test different driving concepts. Vehicles are already an inherent component within Second Life, such that specialized functionality is included in its scripting language. We could customize many of the features that would be impossible in the real world, such as traffic, streets, signs, trees, etc.

We purchased land in Second Life, and began building a virtual closed course to test the A-HUD. Streets and signs were built, and natural terrains such as trees were added for effect. The functionality of A-HUD was programmed partly into the vehicle, and in some cases, into the environment. Our environment was a realistic, customizable, closed course where we could test A-HUD’s functions, change the design as needed, and continue to develop new ideas. With complete control over the structure and design of our environment, we can continue to refine the A-HUD until it has matured to warrant a more realistic simulator.

Within a short period of time, we can already investigate different A-HUD HCI components using our vehicles in Second Life. We have begun examining distances for artifact augmentation, choices of color and text, driver awareness, reaction time, and several other research questions. For example, several of the developers were tasked with driving past street signs to help determine an optimal distance for visual augmentation. These results will help us when creating more concrete scenarios for general user testing.

We also plan to repeat other HUD studies that used different environments [2][3], and see if we produce comparable results. While many of our explorations are simple, our methods have demonstrated Second Life as a capable virtual environment as an early conceptual HCI driving simulator.

4. CONCLUSION
Currently, we know of no other research that uses Second Life for the purpose of testing automobile HCI designs. Compared to developing an in-house simulator or purchasing/leasing existing car simulators, Second Life takes considerably less development time and costs much less. It provides a functional environment where we can develop freely using LSL, customize any artifacts, and perform tasks that would not be practical in the real world (e.g. move road signs around). We acknowledge that Second Life does not replace more realistic automobile simulators and do not recommend it as such, but rather as a low-cost, rapid development platform.

5. REFERENCES
