Research Report Summary

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Multi-Modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians

A collaborative project between the University of Wisconsin-Madison and the University of Iowa was conducted to investigate the feasibility of conducting driving and pedestrian simulator experiments that involve multiple agents (humans) in the simulation. As a parallel effort, the University of Massachusetts-Amherst evaluated the feasibility of conducting distributed driving simulation experiments using an existing driving simulation platform.

Research Objectives

- Develop a simulation platform that allows having multiple agents (drivers and pedestrians) as part of a single simulation environment.
- Test the latency of the simulation environment when experiments are conducted at two geographically distant locations.
- Explore the feasibility of integrating the platform developed with other widely used simulation platforms.

Creation of Simulation Platform

A distributed simulation platform was created using the Unity game engine by integrating code capable of handling simple driving tasks and code capable of handling a pedestrian simulation environment that relies on the HTC Vive virtual reality headset.

Integration of Pedestrian and Driving Simulators

Existing networking capabilities provided by the Unity game engine were used to make it possible for a pedestrian and driver on different locations to share a simulation environment.

The environment created involved a pedestrian and driver interacting at a crosswalk. Figure 1 shows a screenshot of an example of a scenario segment.

Figure 1. Scenario screenshot

Latency Tests

The created platform was used to test a distributed simulation involving two agents, a pedestrian and a driver. The pedestrian was in Iowa City, IA, while the driver was in Madison, WI.

Latency evaluations conducted during the test found an average round-trip latency of 200 ms, thus suggesting an average one-way latency of 100 ms.

Future Research Enabled

The technology demonstrated can be used to study the nature of complex vehicle and pedestrian interactions, and the findings can be used to improve existing agent-based simulation tools used by traffic engineers.

Through multi-agent simulations, as in the procedures demonstrated, the behavior of multiple drivers that interact can be studied, thus making it possible to develop better risk-taking models for use in the traffic safety field.

Testing and Development Process

Development involved a series of tests conducted by having the research team from the University of Iowa and the University of Wisconsin-Madison participate in a distributed simulation. Figure 2 shows a typical test in which the view of the simulation environment from the driver and pedestrian perspectives (wearing an HTC Vive) were compared to make changes to the simulation platform. In the figure, the pedestrian shown is part of the simulation.

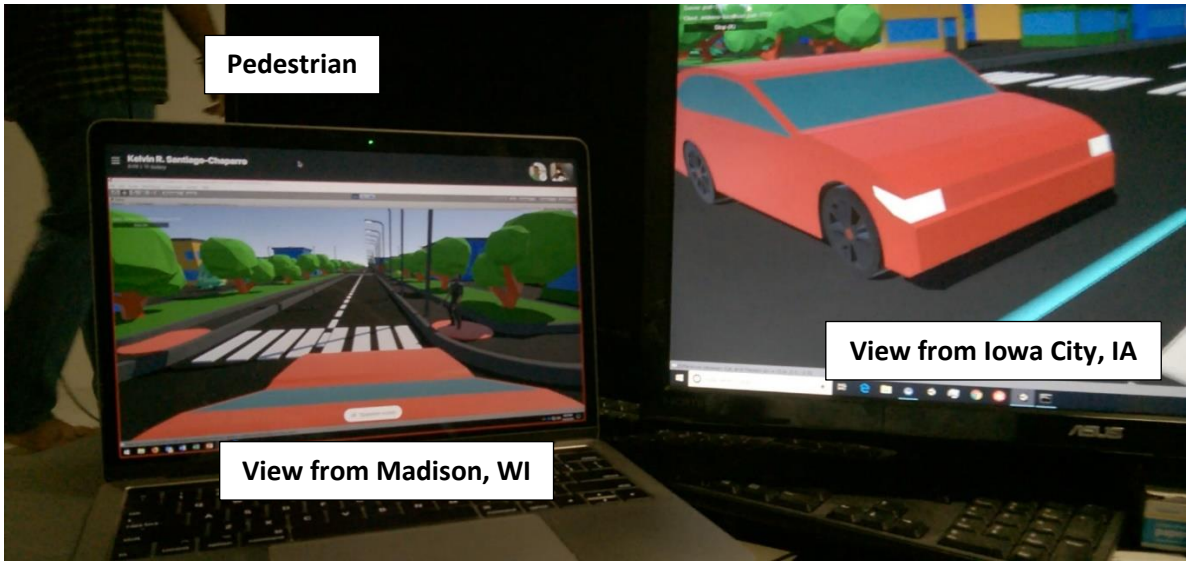

Figure 2. Typical environment used for testing and development

Feasibility of Using Existing Platform as the Control for the Platform Developed

Modules developed to test a distributed simulation environment include the ability to receive steering, brake, and gas pedal data from an external system over a network connection using UDP. An existing full-scale RTI simulator was configured to stream data via UDP. As a result, the feasibility of controlling the simulator platform created using the Unity game engine with a full-scale vehicle cabin was demonstrated. Figure 3 shows a photo taken during the testing process; in the photo, a Unity-based test environment controlled by the RTI vehicle cabin is shown.

Figure 3. Integration of Unity-based simulator and RTI vehicle cabin