大学共同利用機関法人 情報・システム研究機構
国立情報学研究所
National Institute of Informatics

Director General: Masaru Kitsuregawa

July 1, 2013

Virtual Living Lab – An Open Lab for Science Innovation and Super-Large Scale Collection of Human Driving and Travel Behavior Data
Tokyo-Brisbane Live Double-Launch of iCO_2 eco-safe driving practice tool

Researchers from the National Institute of Informatics have developed the Virtual Living Lab, an experimental and participatory three-dimensional (3D) space, as part of the "Global Lab" NII Grand Challenge project. The work was conducted in collaboration with the Smart Transport Research Centre at Queensland University of Technology in Brisbane.

A key driver of the Virtual Living Lab (VLL) is to contribute to eco-sustainable and optimized transportation. The difference to a traditional Living Lab is that our lab is embedded in a massively multiuser 3D virtual environment, also called 3D Internet, rather than the real world. Therefore, our Living Lab is "open" – it can be accessed by anyone, from anywhere, anytime.

The Virtual Living Lab (VLL) comprises two complementary aspects. From the researchers' perspective, the VLL is an experimental space for testing innovative technologies and policies in the transportation domain. The VLL supports realistic simulation of driving and traffic. Therefore, it enables scientists to accurately estimate the impact of smart Intelligent Transport System (ITS) measures on human driving behavior and traffic flow. From the users' perspective, on the other hand, the VLL is a participatory space where "game-like" elements support the entertaining interaction of multiple users with each other and the environment. So, for the user it's fun – and for the researcher it generates highly valuable data.

As one concrete example of a VLL, we introduce the iCO_2 application at the event. iCO_2 is an novel eco-driving training environment, where multiple users can practice eco-safe driving in a shared simulation in both cooperative and competitive ways. To support super-large scale data collection, iCO_2 can be experienced on different platforms using different input methods: iCO_2 on Facebook uses the mouse device and iCO_2 on the iPad is operated via touch and tilt. We will launch the Facebook and iPad applications during the event.

The special feature of the event will be a live video streaming connection to Queensland University of Technology (QUT) in Brisbane. There, iCO_2 will be launched on the large display screen of "The Cube by QUT", where four users will engage with the application simultaneously via touch-based interaction.

[The grayed part has already been translated for the Press Release Announcement.]

Background and Further Information

The world is experiencing a period of rapid urbanization, with more than 60 percent of the world population expected to live in cities by 2025. This situation creates unprecedented economic opportunities, but also several challenges. According to the assessment of IBM, cities face four

high-impact areas of improvement: (1) reduce congestion in transport systems, (2) improve public safety and emergency response time, (3) improve education and training, and (4) enable access to healthcare. To address those challenges, companies from the ICT (Information and Communication Technology) sector and cities promote “Smart City” technologies, including smart mobility, smart environment, smart governance, and so on. A city can be called “smart” if it supports sustainable economic development, high quality of life, and fosters participation and engagement of citizens (en.wikipedia.org/wiki/Smart_city). Notable contributions from the academic field include the Future Cities Laboratory by ETH Zurich and Singapore’s National Research Foundation (futurecities.ethz.ch) and the recently launched “City Science” initiative by the MIT Media Lab (cities.media.mit.edu).

One important aspect of Smart City R&D is the realistic simulation of driving and traffic with the aim of investigating the impact of smart ITS measures on human driving behavior and traffic flow. Simulation refers to the imitation of real-world processes such as driving a car or traffic by using a driving simulator and traffic simulator, respectively. Using networked 3D virtual environments has already been promoted in the social science field, e.g. in the *Science* magazine [1]. In our own work, we have focused on developing an authoring tool for specifying traffic situations, such as the creation of an accident, to enable controlled driving behavior studies in the 3D environment [2,5,6]. To test the impact of a Cooperative Intelligent Transport System (ITS) strategy on CO_2 emissions, we implemented a Green Light Optimized Speed Advisory (GLOSA) application that informs the human drivers, i.e., humans operating a driving simulator, and vehicles controlled by the traffic simulator about the optimal speed for passing the next traffic signal without stopping [3].

iCO_2 Eco-safe Driving Practice Tool

As a concrete example of the VLL, we have developed iCO_2, an online tool for practicing eco-friendly driving in a multi-user three-dimensional environment. The work was published in the most prestigious conference in this field [4].

For researchers, iCO_2 provides an environment to investigate and test novel strategies to reduce CO_2, such as eco-feedback advice or traffic control, at city scale. To draw valid conclusions from data, it is important to collect super-large scale data. This can only be achieved if the driving in the city space is entertaining.

For the user, therefore, iCO_2 has to be a fun interaction space. This is achieved via two core methods.

1. Real-time challenge balancing: iCO_2 supports eco-driving practice by instructing computer-controlled agents, such as traffic lights and other vehicles, to create traffic situations that make eco-driving more difficult. Hence the agents take the role of “opponents” that try to achieve the optimal challenge level for the skill level of each user.
2. Scoring and ranking system: In iCO_2 there are two game modes (incentive schemes), each with their own scoring system.

a. In “free ride” mode, users have a limited amount of fuel and have to save it via eco-driving to drive as far as they can. The users are scored and ranked based on their travelled distance.
b. In “campaign” mode, users have to perform missions and are scored and ranked based on axes like “total time”, “break usage” and “budget spent”.

Website: https://sites.google.com/site/ico2globallab/home

Screenshot of the main interface

Screenshot of the user driving with other players

Screenshot of the “bird’s view”, where the camera floats above the street

Screenshot of this scoring interface

References

1. W.S. Bainbridge. The scientific research potential of virtual worlds. Science, vol. 317, 2007, pp. 472-476.
2. K. Gajananan, A. Nantes, M. Miska, A. Nakasone, and H. Prendinger. An experimental space for conducting controlled driving behavior studies based on a multiuser networked 3D virtual environment and the Scenario Markup Language. IEEE Transactions on Human-Machine Systems, 2013. (In press.)
3. K. Gajananan, S. Sontisirikit, J. Zhang, M. Miska, E. Chung, S. Guha, and H. Prendinger. A cooperative ITS study on green light optimization using an integrating traffic, driving, and communication simulator. Annual Conference of 36th Australasian Transport Research Forum (ATRF), 2013. (Abstract accepted.)
4. M. Madruga and H. Prendinger. iCO2: Multi-user eco-driving training environment based on distributed constraint optimization. Proc. 12th International Conference on Autonomous Agents and Multiagent Systems, Saint Paul, Minnesota, USA, pp. 925-932.
5. H. Prendinger, A. Nakasone, M. Miska, and M. Kuwahara. OpenEnergySim: Conducting behavioral studies in virtual worlds for sustainable transportation. Proc. IEEE Forum on Integrated and Sustainable Transportation System (FISTS'11) , Vienna, Austria, 2011.6, pp. 60-65.
6. H. Prendinger, K. Gajananan, A.B. Zaki, A. Fares, R. Molenaar, D. Urbano, H. van Lint, W. Gomaa. Tokyo Virtual Living Lab: Designing smart cities based on the 3D Internet. IEEE Internet Computing, 2013. (Conditionally accepted.)

Research related queries:
Helmut Prendinger, Professor
E-mail: helmut@nii.ac.jp
Phone: 03-4212-2650
Website: http://research.nii.ac.jp/~prendinger/

National Institute of Informatics Publicity Team
Noriko Bannai
E-mail: bannai@nii.ac.jp
Phone: 03-4212-2164
Fax: 03-4212-2150