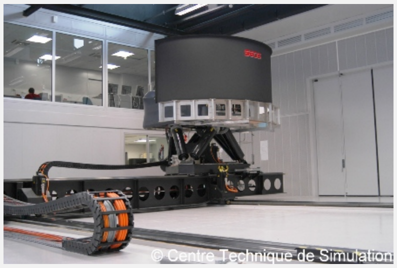
Industrializing Acquisitions on a Renault Driving Simulator with LabVIEW



The Ultimate driving simulator makes sensations felt by the driver very realistic and compliments tests on the road.

"The application uses NI shared-variable technology, which makes information accessible on the network."
- Valérie Hellequin, Arcale

The Challenge:
Updating the acquisitions section on a driving simulator to study systems that target better road safety.

The Solution:
Using NI LabVIEW software, field-programmable gate arrays (FPGAs), and real-time technologies to improve system reliability and duplicate actual driving conditions.

Author(s):
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French car manufacturer Renault employs 8,000 to 10,000 people within the Guyancourt Technocenter. Located on-site, the Centre Technique de Simulation (CTS) dedicates resources to developing the “digital vehicle,” building on virtual modelling and driving simulation tools.

Our company, Arcale, was consulted to evolve and improve the Ultimate driving simulator device, which would consist of a display screen and a multipurpose driving cockpit (Laguna 3 type), instrumented, and installed on a hexapod and an X-Y rail mobile platform. The user can conduct virtual tests regarding driving comfort and road holding, and implement driving-assisted systems.

The System Principle

The SCANNeR driving simulation software, initially developed by Renault, supervises the global platform, which integrates a dozen computers and workstations. They monitor the noise environment during test, simulation, and traffic.

The acquisitions section consists of a computer in a real-time environment linked to an 8-slot PXI chassis via fiber optic cables. The real-time application communicates with another computer running a Windows OS on which an Ultimate man-machine interface can let a user visualize the sensor data.

In the PXI chassis, we used an NI PXI-7831R multifunction reconfigurable I/O (RIO) module to control analog and digital I/O sensors located on the cockpit, a 2-port NI PXI-CAN module to communicate with the vehicle units, and a serial board that interfaces with a 3-axis accelerometer using an Arcale instrument driver. The architecture consists of a real-time part running on a remote target and a Windows OS for remote target control.

Meeting the Needs Requested by Renault

The CTS had several requirements. First, it was mandatory to improve the performance of force feedback to the driver to closely imitate reality. However, we needed to develop an operating application that was easy to debug so the user could easily track data. In addition, scalability is essential in the research field for anticipating cockpit hardware improvements.

Developing a Solution That Closely Imitates Reality

The Ultimate software was developed in the LabVIEW graphical programming environment and uses the LabVIEW Real-Time and LabVIEW FPGA modules. We suggested developing an architecture divided into three independent modules, which are coded into stand-alone elements:

- The model layer (embedded or external)
- The hardware layer [controller area network (CAN), data acquisition, and PXI modules]
- The unit layer (steering wheel, lever switch, and doors)

In the core of the application, the deterministic section controls the acquisition and analysis of the cockpit sensors and the transfer of acquired data to the vehicle model via a reflective memory, which ensures the exchange of data, including information from the brakes, steering wheel, indicators, and gear ratios within the vehicle simulation model. Nearly 60 pieces of information are transferred between the target and the host at a rate of less than 1 ms.

The Windows OS helps users remotely trigger the vehicle cockpit sensors and actuator controls, display sensors while driving, and communicate with the monitoring module to report software faults and save errors. The application uses NI shared-variable technology, which makes information accessible on the network. The Ultimate man-machine interface links the data to the operator.

To complement the project, we developed the system while integrating a control experiment. Each test is associated with a log file notifying a set of user-editable parameters and recorded errors. First, a test process occurs to establish the connection between the target and the host, ask for the test parameter file, direct the experiment, and disconnect and loop on the first stage.

Software Pooling

We spent two–and-a-half months updating the system because we were able to reuse existing code. Furthermore, we may have to use innovative technologies and edit the initial configuration depending on the considered applications, which makes scalability essential.

Today, the acquisitions section of the Ultimate driving simulator is operational and used by external and in-house customers, including PhD students for their academic courses and Renault services. We have also been tasked with porting the application on other Renault simulators for simulation software pooling.

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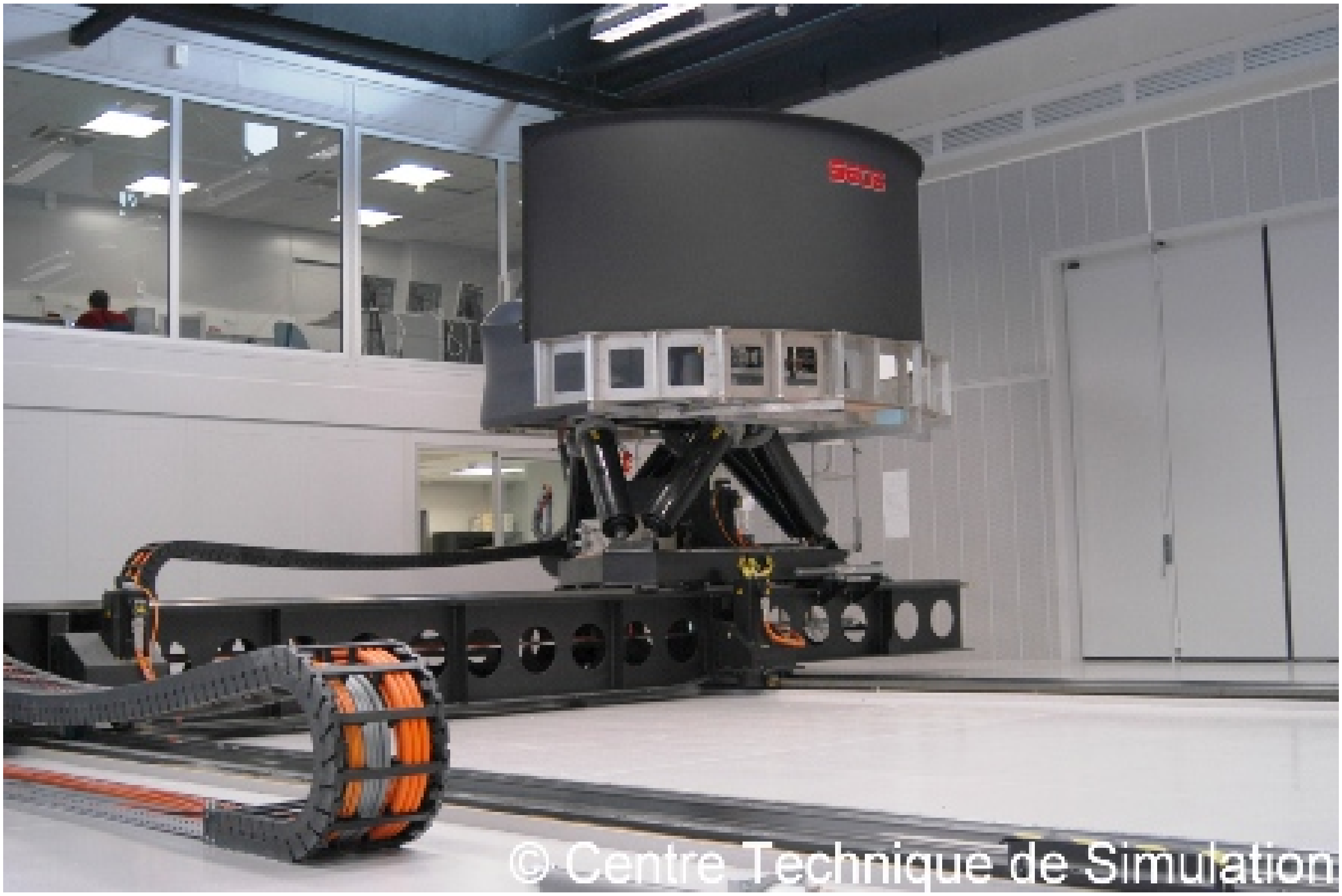

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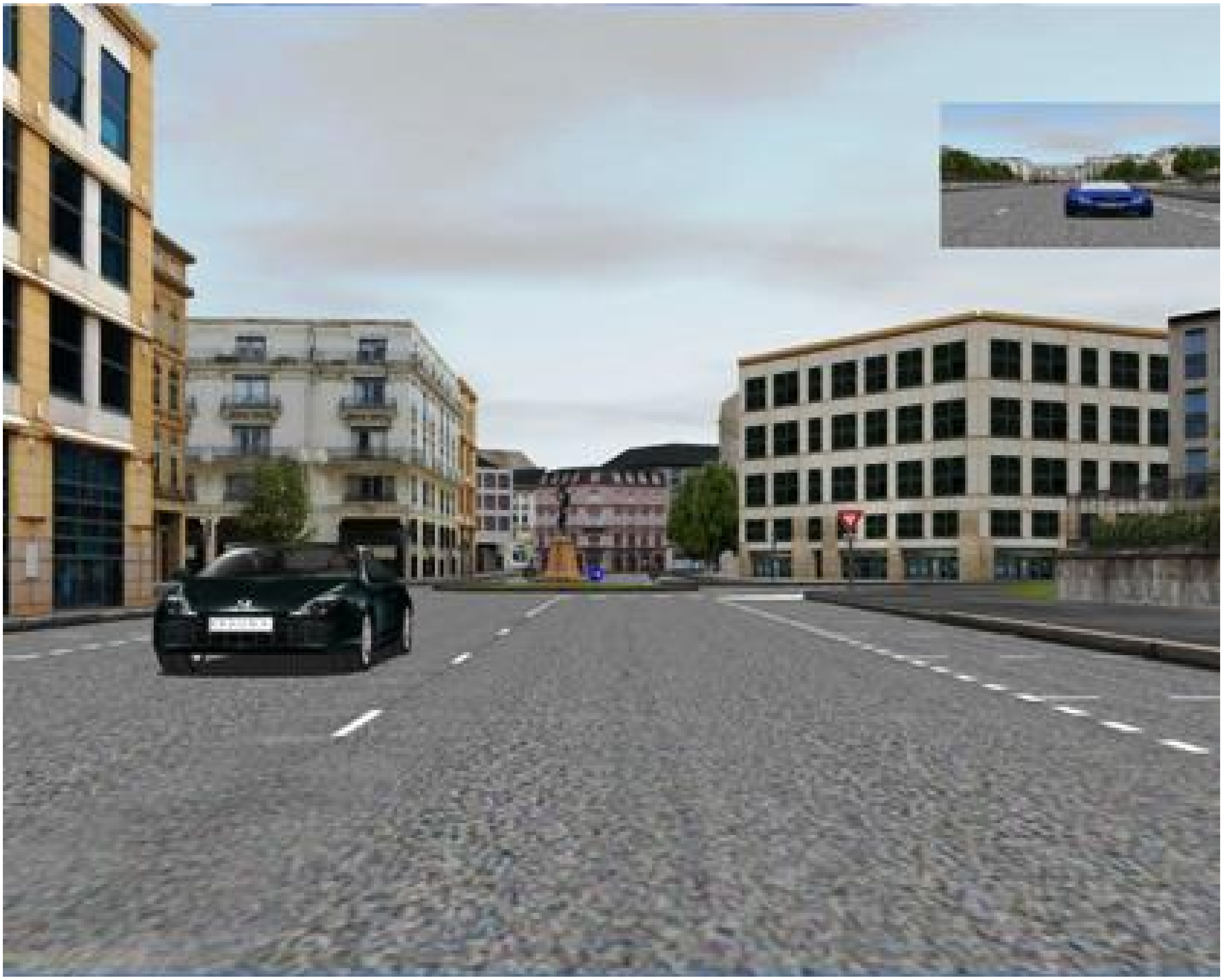
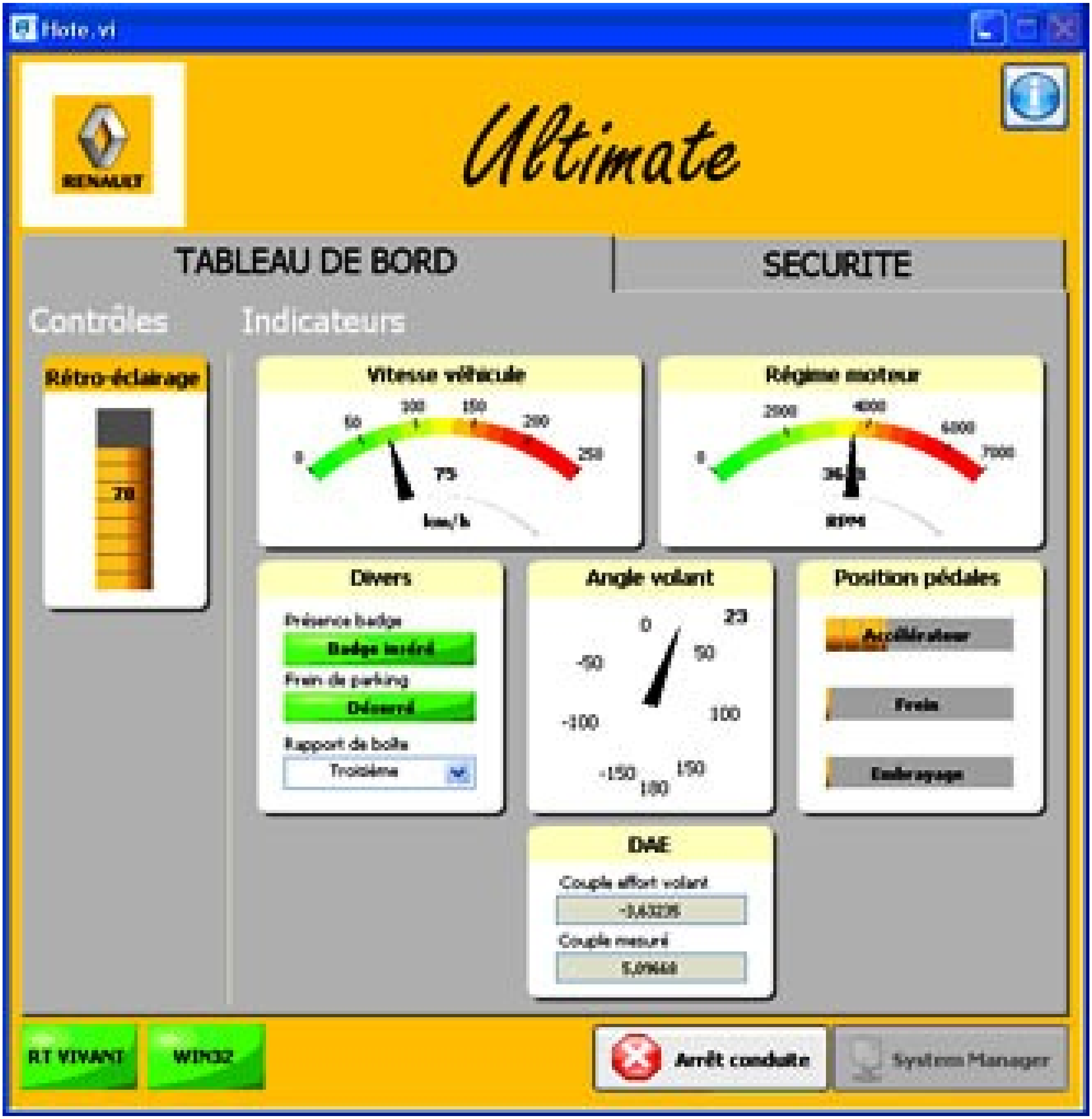


The SCANNeR software suite duplicates real driving scenarios including traffic, images, movement, and noise.



The Instrument Panel Tab of the Ultimate Man-Machine Interface

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