Prototyping an Electric Buggy with LabVIEW and CompactRIO

The All-Electric Buggy Team

"Because CompactRIO is easy to program, we can use it to prepare our students for careers in industrial electrical engineering and computer science."

- Ghislain REMY, IUT de CACHAN

The Challenge:

Transforming a gas-powered buggy into an electric buggy to create a fun way for students to learn the principles of real-time command, control, and supervision.

The Solution:

Using NI CompactRIO hardware and LabVIEW software to control and monitor the electric drive of the buggy and a PC with a touch screen to steer and oversee the system, record the data, and finally propose a visualization of the driving range.

Author(s):
Ghislain REMY - IUT de CACHAN

Since 2009, the IUT de Cachan has heavily invested in teaching its students about command and real-time control systems. With recent developments towards widespread commercialization of carbon-free vehicles such as electric and hybrid cars, the industry has a great need for skilled technicians and engineers that can work on these new applications. Thus, we developed a technology platform using six CompactRIO systems for a variety of electric vehicles including the Segway, an electric wheel motor, and the electric buggy.

CompactRIO: An Essential Component for Project-Based Teaching and Learning

The life of our projects may vary from two to 17 weeks; therefore, we needed a rapidly reconfigurable, highly modular, and easy-to-implement solution. The CompactRIO platform was a perfect choice for our all-electric buggy.

Students can use the CompactRIO Ethernet connection to work on several stations to run programs developed in LabVIEW and to carry out vehicle supervision, making it a suitable solution for teaching large groups.

Because CompactRIO is easy to program, we can use it to prepare our students for careers in industrial electrical engineering and computer science. Our students can use LabVIEW graphical programming to easily get started developing CompactRIO applications. Additionally, each student who owns a copy of LabVIEW Student Edition can develop part of their code at home, which encourages students to become more involved in the project.

Finally, this solution has established a strong link between National Instruments and the IUT de Cachan, which led to sponsorship of the buggy and LabVIEW training for students in our school.

Adjusting the Electric Motor With a Real-Time Monitoring System

We chose the engine battery-chopper and DC motor for the electric buggy based on their simplicity. The goal of this project was to teach our students the different skills necessary to operate the vehicle using the following tools:

- Vehicle instrumentation including Hall effect, current, voltage, and capacitance sensors to control the vehicle's speed
- Data acquisition and processing hardware
- Touch panel display to drive the vehicle

The NI PPC-2115: A Human Machine Interface for Touch Panel Supervision and Control of the Vehicle

We chose to install an NI PPC-2115 touch screen panel PC in the vehicle. Although power consumption is high for this component with nearly 100 W dissipated, it can run all programs developed by the students and it supports LabVIEW, which facilitates rapid development of code in the vehicle. We can also run a full version of LabVIEW and 3D models on the PPC-2115 and we can incorporate video into the vehicle without impacting the CompactRIO system operation. The exchange between the touch screen PC and the CompactRIO is easily handled by the system through shared variables and the Gigabit Ethernet port. The data exchange is seamless when operating the vehicle.

Three Months of Prototyping

Because of CompactRIO, the complete vehicle prototype was ready after about three working months. The final prototype was able to travel 30 km with a peak speed of 35 km/h.

CompactRIO Removes Development Limitations

Our students are constantly suggesting improvements to the electric buggy, which are possible because of the modularity of the CompactRIO platform. Additional projects we are working on with the electric buggy include the following:

- Reverse operation aided by an NI 1722 Smart Camera
- Cruise control operated by the PPC-2115 touch screen panel
- Radar proximity and a collision avoidance system with a ZigBee sensor communicating with a module we developed using the NI cRIO-9951 module development kit
- Remote monitoring of vehicles via GPS and GPRS with modules developed by S.E.A. Datentechnik GmbH

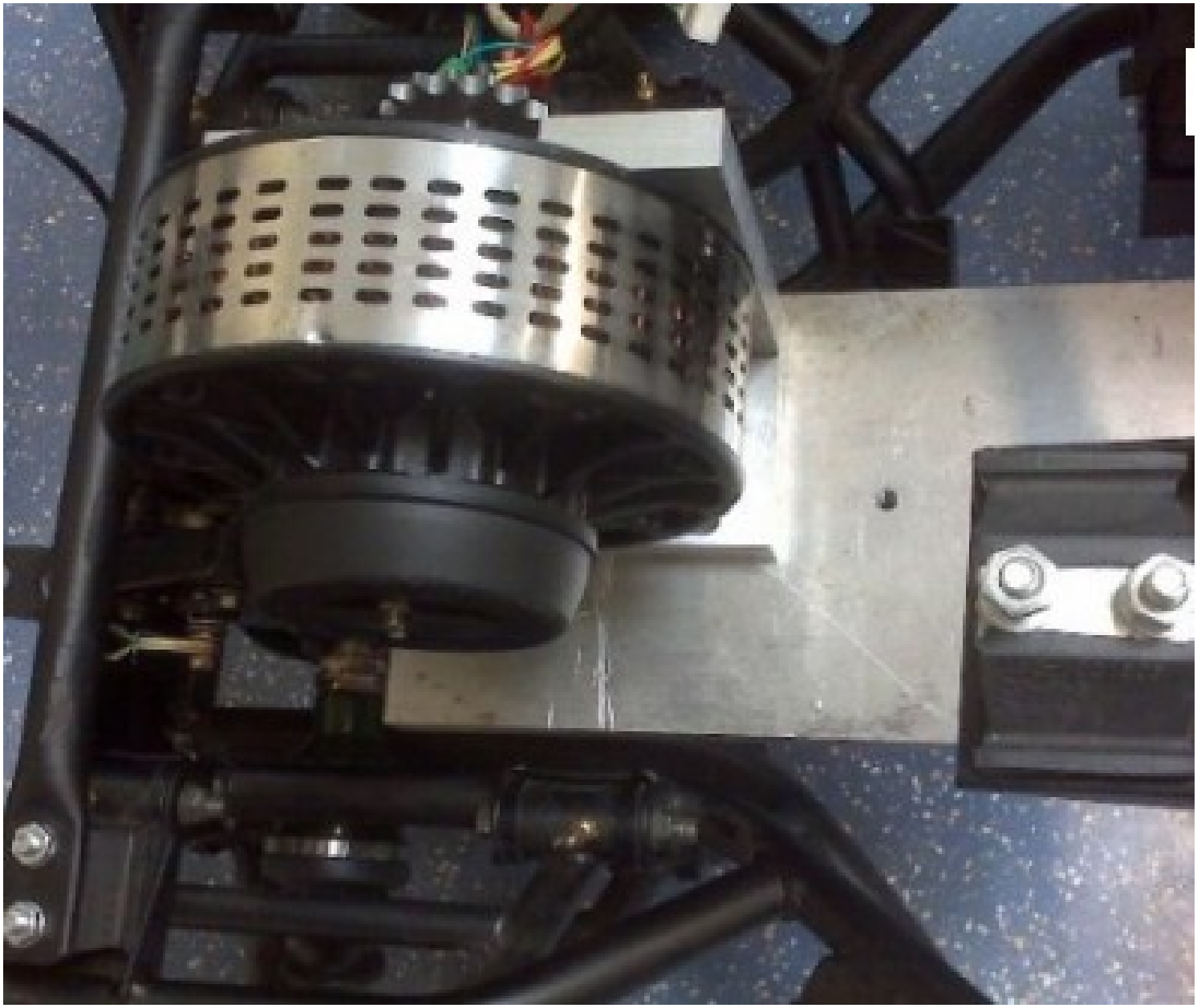
The results of this work will be included in a forthcoming publication.

Thank you to the teaching staff and technicians, without whom this work would not fare as well including Jean-Yves Le Chenadec, Patrick Ruiz, Eric Laboure, and Marc Ardillier, Vincent Gourcuff and Denis Pénard.

Author Information:
Ghislain REMY
IUT de CACHAN

9, avenue de la Division Leclerc - BP 140
94234 CACHAN CEDEX
France
Tel: +33 (0)1 41 24 11 57
ghislain.remy@u-psud.fr

The All-Electric Buggy Team



DC Motors Make Development Simple and Effective

The power cabinet contains four 12 V batteries, 48 Ah, and each battery is associated with a charger. Additionally, the variable speed is controlled by the CompactRIO.

The control cabinet with chassis cRIO-9114 controller equipped cRIO-9022 and PPC-2115 screen, is close to the driver so he or she can receivedirect visual feedback and tactile control.

The first all-electric buggy test conducted by the students.

Legal
This case study (this "case study") was developed by a National Instruments ("NI") customer. THIS CASE STUDY IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND AND SUBJECT TO CERTAIN RESTRICTIONS AS MORE SPECIFICALLY SET FORTH IN NI.COM'S TERMS OF USE (http://ni.com/legal/termsofuse/unitedstates/us/).