# Researchers customizing electric cars for cost-effective urban commuting

November 16 2009

Researchers at Carnegie Mellon University's Robotics Institute have converted a 2001 Scion xB into an electric commuter vehicle that will serve as a test bed for a new community-based approach to electric vehicle design, conversion and operations.

The vehicle is part of a new research project, ChargeCar, headed by Illah Nourbakhsh, associate professor of robotics. The project is exploring how electric vehicles can be customized to cost-effectively meet an individual's specific commuting needs and how an electric vehicle's efficiency can be boosted and its battery life extended by using artificial intelligence to manage power.

"Most electric cars today are being designed with top-down engineering to match the performance of gas-powered cars," Nourbakhsh said. "Our goal is to revolutionize urban commuting by taking a different approach — by first analyzing the needs, conditions and habits of the daily commutes of actual people and then using this 'commute ecology' to develop electric vehicles suited to each unique commute." The researchers calculate that a typical Pittsburgh commuter might save 80 percent of energy costs by switching from a gas car to an electric car.

ChargeCar isn't developing new vehicles, but rather a knowledge base that can be used to convert gas-powered vehicles using existing technology. The researchers are working with Pittsburgh mechanics to develop community-level expertise in vehicle conversion, as well as a set of conversion "recipes."

Key to the project is a vehicle architecture called smart power management, which uses artificial intelligence to manage the flow of power between conventional electric car batteries and a device called a supercapacitor. Supercapacitors are electrochemical capacitors with unusually high energy density and have typically been used to start locomotives, tanks and diesel trucks. Because it can store and rapidly release large amounts of electrical power, a supercapacitor can serve as a buffer between the battery pack and the vehicle's electric motors, improving the vehicle's responsiveness while reducing the charge/discharge cycling that shortens battery life.

"Many people have talked about using supercapacitors as buffers on a battery, but we also will use artificial intelligence to manage how power is discharged and stored," Nourbakhsh said. "Based on a driver's route and habits, the smart power management system will decide whether to draw power for the electric motors from the batteries or the supercapacitor and decide where to store electricity produced by the regenerative braking system as the car slows down or goes down a hill."

Determining the optimal means of managing power will be one of ChargeCar's primary goals. The researchers calculate that an intelligent electric car controller could recapture 48 percent of the energy during braking and that a supercapacitor could reduce 56 percent of the load on the batteries and reduce heating of the batteries — which shortens battery life — by 53 percent.

"The number one cost of electric vehicle ownership is the batteries," Nourbakhsh said. "Smart power management will save money initially because it pairs a low-cost battery pack with a small supercapacitor. And it will continue to save money by increasing efficiency and extending battery life." By customizing each vehicle to the owner's specific commute, ChargeCar will save money for some owners by allowing them to purchase the minimum number of batteries necessary.

The converted Scion xB will serve as a test bed for developing smart power management techniques, measuring battery lifetimes and refining conversion techniques.

The ChargeCar project has created a national clearinghouse for commuter data at chargecar.org; people across the country are invited to store their commute data via GPS and upload it to the site. The site can then use the data to show individuals the energy cost of gasoline vs. electricity for their commute and also can show how much wear and tear on batteries could be saved on the commute by using a supercapacitor. The researchers will use the database to help them tailor solutions to individual commutes and they will make the database available to all electric car researchers and enthusiasts.

Source: Carnegie Mellon University (news : web)