Technolution

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Going on a journey together

>>cleverly anticipating advances in knowledge

Students from TU Delft had to contend with faults in their self-built solar-powered car. Together with Technolution, they came up with a temporary solution. They are now working on a completely new design.

Nuon Solar Team

“Build an electric car to cross Australia powered entirely by solar energy.” That is the challenge which fourteen students of TU Delft took on in 2008. A year and a half ago, they set aside their studies to design and build Nuna5, drawing on the experiences of four teams that went before them.

In October 2009, Nuna5 came second in the World Solar Challenge in Australia. Afterwards, the car was due to stand idle for nearly a year, until work started on Nuna6. The students wanted to put that year to good use. They wanted to use their experiences to improve Nuna5, in order to give the next group of students a better start with Nuna6. For example, the car was troubled with faults in the voltage converter. This component transforms the energy from the solar cells into a usable form for the car’s electric motor. Technolution wanted to support these students who are passionate about technology with its knowledge and experience in electric propulsion and automotive applications. We could see enough areas where we could make a contribution.

Voltage converter too heavy

The voltage converter is an important link between the solar cells and the motor. It is a Maximum Power Point Tracker, which draws as much energy as possible from the solar cells regardless of the amount of sunlight. In electronic terms it is a perfectly good converter with a good yield. But the mechanical design makes the converter less suitable for use in a car. It is a rectangular PCB which is attached to the car at its four corners. At the centre of the circuit board is the heaviest component; the transformer. When you start moving, the chances of hairline cracks appearing in the printed conductors is high.

As a first step, Technolution and the students thought about ways to improve the suspension. We suggested choosing a heat sink the same size as the PCB and attaching the whole to the car at more points, especially around the transformer. A bigger heat sink also solved a problem with cooling. The original heat sink was not adequate which meant that additional cooling with a ventilator was needed. A waste of energy!

>>Nuna5 achieved third place, with no breakdowns

Suzuka Dream Cup
The modified design was taken to the Suzuka Dream Cup 2010. This is a circuit race which sees forty solar-power cars take to the track at the same time at the Suzuka circuit in Japan – a totally different setting to the endurance race in Australia, where each car individually completes a straight three thousand-kilometre course. Nuna5 came in third, without suffering any faults or breaking down.

Stress & vibration test
We also suggested subjecting the transformer to stress and vibration tests. For an effective vibration test, you first need to know what vibrations the controller is exposed to in the car. To find out, a MobiBoxx was made available. This is a universal in-car platform for telematics applications in vehicles. It has all kinds of connections as standard, including CAN. In addition, it contains a three-axis accelerometer. The MobiBoxx is therefore able to record a vibration profile for the car, which provides the input for a real vibration test. However, in the end, the stress and vibration tests were not carried out. By then, we had acquired so much knowledge together that we were able to skip them. As a first step, we made the transformer stiffer using the large heat sink. Currently, the team is working out the idea of developing an entirely new converter with our support for the World Solar Challenge 2011 in Australia.

Follow-up
The current converter is a heavy component, both in terms of weight and power. But it is essential to the overall energy efficiency of the car. The voltage converter is very efficient, but it can be made much smaller and lighter, so reducing mechanical stress. Building your own converter means you understand everything that is inside it. Which means you can optimally adjust everything at system level in order to squeeze the last drop of performance from the whole car.

MobiBoxx
Because it turned out that there was no need for the relatively expensive vibration tests, the MobiBoxx was not used in Japan. But the platform did gradually come into the picture for other applications. After all, the MobiBoxx was developed as a telematics platform in vehicles. In the Nuna5, the students only used a screen for internal control and data processing. Data transport took place via WiFi to a support car. But support cars are not allowed in some competitions. The MobiBoxx is able to log data itself and communicate it to a computer or back office via GPRS or UMTS. All components in the car are linked with CAN, which means they can be monitored by the MobiBoxx, which also contains GPS. This is handy for positioning, but even more so because GPS can very accurately determine speed. This allows you to record the accelerations of the car. Accelerating costs energy, so you want to drive as steadily and ‘evenly’ as possible. Of course, braking also costs energy, but by braking with the engines, some of the energy can be recovered as electricity.
Everything you measure you can also log. In this way, you can seek to achieve the greatest possible efficiency for all components. The energy consumption of the MobiBoxx is negligible: less than two Watts at an average load. We are currently looking into the possibility of using the MobiBoxx as the central controller for the Nuna6.

The partnership with the Nuon Solar Team is a typical example of embarking on a journey together. Solving a mechanical problem may lead to a completely new design. And using the MobiBoxx offers entirely new opportunities. This is a collaboration in which everything is not laid down at the outset to be implemented in exactly that way. Embarking on a journey together is all about cleverly anticipating advances in knowledge.

World Solar Challenge

The World Solar Challenge is a biennial race through Australia for cars powered by solar energy. More than thirty student teams from all over the world take part. The race goes straight across Australia north-south from Darwin to Adelaide over a course of more than 3,000 kilometres.

Suzuka Dream Cup in Japan