Team Tetrix, Carolo Cup 2014 Sponsorship Proposal

Project Plan Summary

A group of students from Gothenburg University has been assembled to create autonomous, self-driving miniature vehicles. The self driving car will be able to process information in its environment through the processing of images taken from a camera, and data gathered from a variety of sensors. The autonomous vehicle uses the data to follow lanes in a track, to park autonomously on a sideways parking strip, to behave correctly at intersections, and to overtake stationary and moving obstacles.

The teams aims to participate in the international competition Carolo Cup 2014 for self-driving miniature cars that will be held in Germany, hosted by the University of Braunschweig. The competitors will be judged by industrial partners such as Volkswagen, Bosch, and Continental. See this video for a brief introduction to how vehicles perform during the competition.

The students from Gothenburg University are carrying out their project using Erlang and Erlang ALE. While embedded systems often use the C programming language, the students are taking the innovative approach of including Erlang and ALE into the system.

Objectives

1. Implement a robust self-driving miniature vehicle that is capable to follow lane-markings, detect and overtake obstacles and to park autonomously on a sideways parking strip.

2. Create an efficient and embedded system by utilizing the concurrency and parallelism models made available by the Erlang programming language.

3. Control hardware by utilizing Erlang ALE.

4. Create a reliable, fault tolerant, embedded system using the Erlang programming language.

5. Showcase the advantages of utilizing embedded Erlang.

6. Create a system using traditional embedded system practice (such as using the C programming language), and showing that these practices can integrate seamlessly with the Erlang programming language.

7. Display the results of our innovative approach in front of an international setting that is supported by important industrial partners and sponsors:
    a. Aiming to participate with our autonomous driving vehicle at the annual Carolo Cup at the University of Braunschweig

b. Reporting about design and performance in scientific publications

Keys to Success:

There are many factors that can contribute to our success in showcasing Erlang as an solution to power an embedded system at the 2014 Carolo Cup. Fortunately, many of these factors are in line with our strengths as a group, or our experience:

- **Understanding the Benefits of Erlang.** The project was initially worked on for 5 months, working exclusively in C/C++. We have redone our entire framework in Erlang, which gives us an understanding of why Erlang has improved and enhanced our previous work. We will be ready to present these findings to an industrial panel and to summarize them in scientific publications.

- **A Working Prototype.** We have a vehicle that is already able to lane follow, proving that our algorithmic concepts are sound. We are iteratively working on improving our prototype adding more features.

- **On Schedule.** We have internal deadlines set up to ensure that we will a complete self-driving miniature car ready to compete with other German universities in the 2014 Carolo Cup. We have met all our internal deadlines.

- **Developer Availability**. The members of this group are working more than full time hours on the project for the project success.

- **Developer Continuity.** The majority of our developers from January 2013 - May 2013 are still working on the project. High retention rate for us means less risk and having developers with familiarity with the project.

- **Training from Erlang Solutions.** We have learned about Erlang through Erlang Solutions, and are therefore familiar with the best practices emphasized by Erlang Solutions. One of our developers also worked at Erlang Solutions during the summer. We will present solutions to industry that are within industry standards and also publish about the results in comparison to a C/C++ after finalizing the project.

- **Advisors.** Chalmers | University of Gothenburg faculty is advising us throughout the entire development cycle. The faculty members have previously supervised a team that won the 2013 “Junior Carolo Cup,” and who are familiar with any technical issues we may encounter.

Operational Plan

Our project is led by a series of milestones that will lead us towards having a system to a successful presentation for the 2014 Carolo Cup and for subsequent scientific publications. The team itself has its' own management protocols, and at the same time is supervised by faculty at Chalmers | University of Gothenburg.

Milestones

The following represent the milestones we have set up for the group. Up to this date, all milestones have been met.

1. **September 12, 2013**. A presentation of algorithms and lane following in a simulated environment. Occured during a seminar attended by over 200 people, with representatives from Chalmers | University of Gothenburg.

2. **November 1, 2013**. Completed the integration of a prototype that detects and follows lanes of an entire track.

3. **November 25, 2013**. Demonstrating the prototypical running at 'Robotics Week.' Event occurs at the Chalmers | University of Gothenburg, campus Lindholmen.

4. **February 10, 11, 2014** Plan to participate in the 2014 Carolo Cup in Germany.

Management of the Project

Advisors

Christian Berger and Olaf Landsiedel are faculty members from Chalmers | University of Gothenburg. They are advisors for the project, and are supervising the work on the project.

Christian Berger has previous experience working with autonomous vehicles, coordinated the team that participated as best European team in the 2007 DARPA Urban Challenge in the US.

He together with Olaf Landsiedel advised the last year's CaroloCup team from Chalmers | University of Gothenburg that won the Junior Edition.
The group has weekly meetings with the advisors. Every week there is an expected delivery, and the advisors guide the group through technical challenges. The previous milestones were also set by the advisors.

Benefits Statement

Domain and Regional Exposure

We aim to win the Carolo Cup 2014. Since embedded systems has yet to be widely exposed to Erlang, this project will offer an opportunity to promote Erlang's use in embedded systems. By displaying our results to industrial representatives from companies such as Volkswagen, Bosch, IAV, Carmeq, VDE and Continental, we can increase Erlang Solution's exposure to the automotive industry and to embedded-system-applications as a whole.

Since the 2014 Carolo Cup will be hosted in Germany and supported by the automotive industry (OEMs and suppliers), this is an opportunity for Erlang Solutions to get additional exposure in this domain.

Additionally, our project is located in Lindholmen, Sweden. We have displayed our work during technical seminars and conferences (Lindholmen Software Development Day 2013, Robotics Week 2013). Sponsoring of our project also extends to additional regional exposure in Sweden.

We had a previous team that competed at the Junior Carolo Cup 2013, which was sponsored by a local consulting company. Their investment was significantly paid back by the increased exposure they received in news and media coverage.

In the following, there are some links that display this exposure:

HiQ's Logo appearing prominently in press:

Channel TV4 (Swedish)	link
Göteborgsposten (Swedish)	link
Metro (Swedish)	link
BZ (German)	link
Spinionen (Swedish)	link
Motor-Magasinet (Swedish)	link

The results of the project shall be used in scientific papers afterwards that outline the results and conclusions from using Erlang within this specific domain. The students of this project were taught Erlang by Francesco Cesarini, and this occurred as a result of a long-term co-operation with University of Gothenburg and Erlang Solutions. Wider spread interest of Erlang in academia could also lead to wider exposure of Erlang Solutions within universities.

Contributing to Current Research

Since Erlang Solutions is currently researching the use of Erlang within embedded systems (http://www.erlang-embedded.com/), our work can further contribute to what Erlang Solutions has already done. We will summarize our findings in a scientific paper together with our university advisors after finishing the project.

Cost Plan

The current project has had hardware parts, and the testing track paid for by Chalmers | University of Gothenburg. The open position right now are the costs for traveling to the 2014 Carolo Cup in Germany to ensure our participation.

We have planned to be send 9 students from Gothenburg, Sweden, to Braunschweig Germany. The event will take place during the days of February 10 - 11, 2014.

In the following, you find a breakdown of the costs for participating of the last year's team (8 persons):

Position	Cost
2 vehicles	29,000 SEK
Flygbus	1,500 SEK
Flights GOT to TXL	10,500SEK
Train from Berlin to Braunschweig	3,500 SEK
Hotel (5 nights, 3 rooms)	18,200 SEK
Food/beverages	3,500 SEK
Sum:	**66,200 SEK**
Sum of travel costs:	**37,200 SEK**
Travel costs per participant for last year:	**4,650 SEK**

Marketing Plan

The sponsor for the previous year's team stated that they gain increased web activity through the large amount of media publications that included the vehicle and the team from last year.

We anticipate a similar outcome for Erlang Solutions, possibly more since we are utilizing innovative solutions that stand out amongst the other competitors. We would offer:

- A place on the vehicle for Erlang Solutions logo.
- Media publications with the vehicle clearly showing Erlang Solutions logo.
- T-shirts provided by Erlang Solutions that will be worn during media appearances and during the competition.
- A brief introduction to Erlang, embedded Erlang and Erlang Solutions during our presentation in front of the industrial panel and competitors.

Additional Links	
Christian Berger	http://www.christianberger.net/
Olaf Landsiedel	http://www.cse.chalmers.se/~olafl/
Carolo Cup	http://www.carolocup.de/
Best of Carolo Cup 2013 video	http://www.youtube.com/watch?v=ReuRddc-ZW0