AC 2009-771: ENGAGING STUDENTS: THE GROWING SMART-CAR COMPETITION

John McLellan, Freescale

Andy Mastronardi, Freescale

Engaging Students – The Growing Smart Car Competition

Abstract

Whether in the United States, Mexico, China, or other regions of the globe, today's engineering students all have one common characteristic, they get bored easily if not engaged in their learning. One solution is to hold a "Smart Car Challenge." It has all the key ingredients that engage a student – speed, complexity, design, teamwork and competitiveness.

In 2006, the China Ministry of Education initiated a design contest between undergraduate students, racing autonomous model cars around a track. The results have been phenomenal, growing from 112 teams from 59 universities in 2006 to 615 teams from more than 200 universities in 2008. In this paper, you will find out more about China's successful Smart Car Competition and how you can bring a similar race to your school!

Engaging Students

Captivating the attention of students has become a growing topic of discussion from all spots on the globe. Texting, video games, TV, portable devices, and a whole slew of distractive mediums all compete for student attention. When looking at high school aged students the difficulty magnifies drastically in part to lack of motivation, culture, and extracurricular activities.

Competitions that "feel" like sporting events seem to have the best success in engaging students. The learning comes from real-world interactive, hands-on type activities. Additionally, the need for educators is paramount and comes in the forms of professional educators and industry mentors. FIRST robotics[1] has seen great success with this approach.

Likewise, in the US, universities such as Texas A&M[2], Rose Hulman[3], and California University of Pennsylvania[4] to name a few have created similar initiatives to drive prospective students to there academic institutions or to engage current students. However, these competitions have limited similarities and differing objectives. The Smart Car Competition growth rate is a testament to cohesive government, industry, and academia partnerships for a common objective. The more prestigious the event is, the greater the competition, and more likely a student will self-engage, that is, seek out getting involved.

The intent of this paper is not a comprehensive strategy to tackle this huge and complex problem, rather, to showcase a growing International Competition, the Smart Car Competition[5] aimed at engaging students at an early age and teaching the principals of STEM.

History of the Smart Car Competition

The Smart Car race was originally conceived in collaboration with Hangyang University (S.Korea) and Freescale Semiconductor to increase student exposure to cutting edge industry tools. Since the competitions inception in 2003, the event has spread from Korea to China, Malaysia, India and Mexico. In 2008, China alone hosted over 1800 teams from over 600 universities. Overall, the explosive growth of the event is staggering as shown in Figure 1.

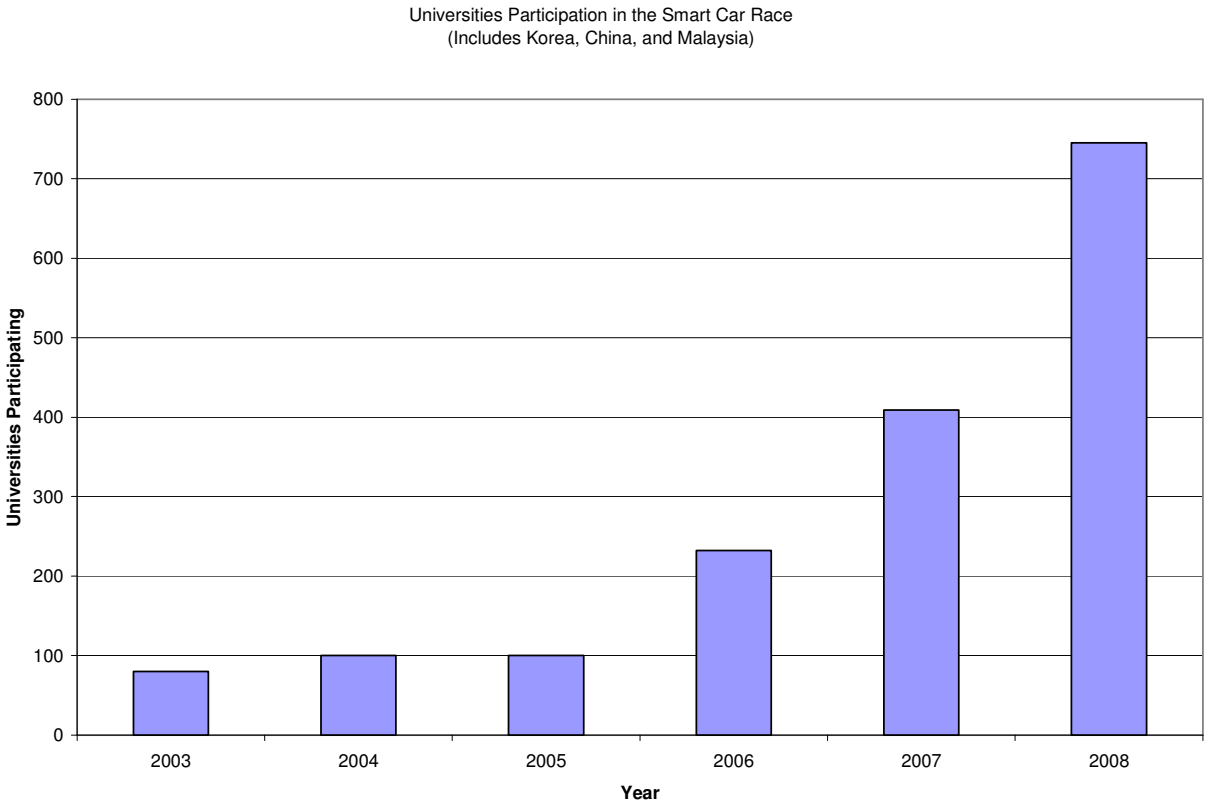

Figure 1 – Smart Car Participation Growth (Source: Freescale Semiconductor)

Currently the success of the Smart Car Competition is a judged by the rapid growth of the competition and the willful continued involvement of it sponsors. As the competition matures and expands into different countries more emphasis will be put in long-term impact to students from participating in this type of activity.

Competition Overview

The Smart Car Challenge[5] pits individual race cars against one another vying for the fastest time around the course. The goal is to autonomously drive around the track as quickly as possible. Teams have multiple attempts, including a qualifying and finalists round, to record the fastest times. Awards are given to first, second and third place winners. Additionally, awards are given for innovative design, technical merit and quality of production as determined by the regions.

The track layout is not known to the challengers until race day. Each year changes are made to the tracks which contain several elements of difficulty including hills, hairpin turns, S-curves, and high speed straight-aways. The surface of the track is white, with a 1 inch black stripe path for the onboard vehicle sensors to track.

Teams are broken down into two divisions, the camera division and the photoelectric division. Camera division entries typically use a CMOS or similar based camera configuration. The

photoelectric division generally uses an IR transmitter and receiver array configuration to get accurate positioning information.

The foundation of the Smart Car is a model Radio Controlled vehicle chassis, transmission, DC motor and servo steering. All RC components are readily available at hobby stores and teams are encouraged to add on to there cars. Intelligence to the vehicle is accommodated through a Freescale microcontroller board. The base components, chassis, electronics, steering, and drive train can are viewable in Figure 2. Not included in the kit is either a CMOS camera and/or IR sensors allow the vehicle to autonomously navigate a high-speed track. Teams are allowed to separate into divisions based on which sensor is used.

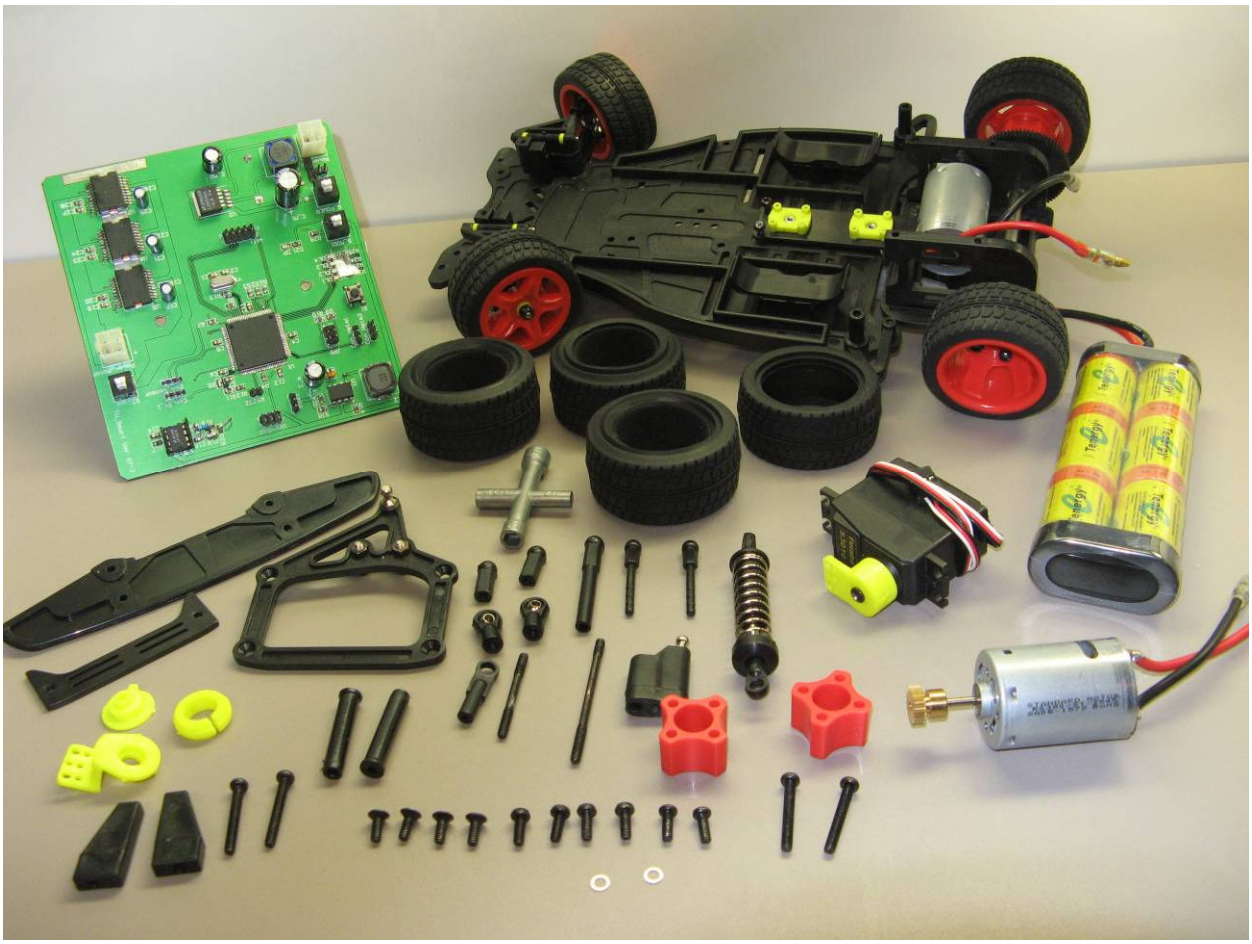

Figure 2 Components of the Smart Car

Since the Smart Cars are "kit cars" there are several opportunities for the educator and event organizer to modify the game and rules if so desired. The simplicity and low-cost of the Smart Cars enable sub-teams to form and compete locally against other teams.

Student Learning Challenges

The racing challenge component is fairly simple. For the teams however, executing a successful autonomous high speed Smart Car is far from simple. During the design and construction phase

of the challenge students must tackle several Science, Technology, Engineering, and Math (STEM) related issues such as embedded microcontroller programming, closed loop control calculation, modeling and implementation, as well as overall vehicle dynamics (physics). Soft skills are likewise emphasized through team collaboration, design documentation, and project management.

Creating a high-speed race car is the apex of the challenge. High speed control coupled with the unpredictable track design creates some spectacular problems to solve and just as common some spectacular crashes. For example, in 2007, many teams came prepared for a flat fast track, but the introduction of a large hill required quick design changes, and quick fixes, to mount cameras higher so that line-of-sight to the black line could be kept. In 2008, a very tricky high speed straight-away followed by a hairpin turn claimed many a racer, emphasizing speed control was just as critical as direction control.

One of the constant challenges for a technology based competition is to keep the focus on the challenge and not the technology tools. Educators are at the forefront of student education and need to be backed by the expertise of industry. One aspect that contributes to the success of the Smart Car challenge is the microcontroller training sessions which precede each event. With the shear numbers of students typically involved tool providers (industry) must rely on educators to bear the brunt of questions. However, industry must efficiently and effectively train the trainers for this concept to work. In China, the Ministry of Education has embraced the event making it standardized curricula across several of the leading universities.

Conclusion

Automobiles are a part of most developed countries everyday lives. The scientific principals binding an automobile are easy for students to indentify with and relate to. Racing is a challenge that virtually every human knows, has no language barriers, and never fails to provide excitement, adrenaline and with it a platform to educate. The organization of hundreds of universities, with the help of government support, truly takes the event to the next level, prizes are more prestigious and competition more fierce.

In an attempt to spur more STEM based learning Freescale embraces learning initiatives like the Smart Car challenge. In addition, other featured K-12 activities such as BEST (Boosting Engineering, Science and Technology) and FIRST (For Inspiration of Science and Technology) robotics and college level challenges like EcoCar.

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