Sponsoring a FIRST Robotics Team

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Abstract *? High schools across the country are participating in a national design competition called FIRST—For Inspiration and Recognition of Science and Technology. Participating schools design and build a robot that must work with a partner robot to complete certain goals more effectively than a competing pair of robots. The purpose of the organization is to encourage high school students to become excited about engineering and science. Corporations and universities near each high school are invited to assist the students by providing supplies, resources, or expertise. In this paper, we will describe the benefits obtained by universities that participate in this annual program.*

INTRODUCTION

The FIRST (For Inspiration and Recognition of Science and Technology) competition teams high school students, sponsors, universities, and technical professionals to design a robot that can meet a prescribed challenge. The goal of the competition is to give the students a positive experience in the field of science and engineering, in the hope that they will strongly consider a career in one of these fields.

The FIRST competition was created in 1992 by Dean Kamen, well-known inventor of the first commercially available insulin pump, the iBOT™ Mobility System, and the Segway™ Human Transporter, along with 150 other products. The first competition drew 28 teams and was held in a high school gymnasium; last year's 23 regional competitions and the national competition at the EPCOT center in Orlando, Florida, drew 20,000 students and 800 teams from almost every state and several other countries.

The rules of the competition are announced every year in early January, and the teams and their sponsors have approximately six weeks in which to design, build, and test their robotic entry. Once this work is done, the robots are shipped to the regional competition site, where they will await their owners' arrival.

Although each team designs and builds its own robot, the actual competition is performed by coalitions of two teams working together. These coalitions are assigned randomly during qualification rounds, but the highest-performing teams are given the opportunity to select their coalition partners in the final rounds of the tournament.

The rules of the competition are different every year, meaning that teams are not able to complete a substantial amount of their design before the competition is announced in early January at a nation-wide kick-off event. At this event, each team also receives a standard kit of parts that includes carefully selected motors, batteries, radio links, and microcontrollers. A wide selection of mechanical components is also included, and teams are encouraged to develop their own custom parts to improve the performance of their robots.

THE 2003 COMPETITION: STACK ATTACK

For the 2003 competition, each coalition will attempt to move large plastic bins onto their side of the field and, if possible, to stack those bins as high as possible. The playing field is 24 feet wide by 54 feet long, and it is enclosed on all sides by a pipe railing. In the middle of the playing field, there is a two-foot-high platform that can be reached by climbing an eight-foot ramp that is covered with welded steel-wire mesh. The top of the ramp is made of plastic, while the rest of the playing field is covered with carpet of different colors. The playing field is shown in figure 1.

At the beginning of the event, twenty-nine bins will be stacked on the top of a ramp between the blue zone and the red zone. These twenty-nine bins will be laid out to form a pyramid, with seven bins each on the first, second, and third tiers, five bins on the fourth tier, and three bins on the sixth tier. The drivers will stand at the ends of the playing field, and the two robots for each coalition will start at the opposite end of the field from their drivers.

The areas covered with red and blue carpet in figure 1 are the scoring zones for each coalition. Each coalition will attempt to move as many bins as possible into this scoring zone during the two-minute event.

For ten seconds before the event begins, two human players from each coalition will have an opportunity to strategically place a total of eight bins anywhere on their side of the field. They can be placed in two stacks of four, one stack of eight, or any combination of stacks of varying heights.

For the first fifteen seconds of the competition, all four robots will be acting autonomously. They will use on-board sensors and pre-programmed strategies to knock down their

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opponent's stacks, to push bins into their own scoring zones, or to interfere with the actions of the other coalition's robots.

The remaining minute and 45 seconds will be under the control of the human team members, who will communicate with their robots using wireless links. During this time, the robots will continue to try to move as many bins as possible to their own side of the playing field, stack them as high as possible, and knock over their opponent's stacks.

At the end of the competition, each coalition's score is determined by multiplying the number of bins in their scoring zone by the height of the tallest stack in the scoring zone. Each robot completely on top of the ramp at the end of the event will also receive a 25-point bonus for their coalition.

A more complete description of the competition rules and a video simulation of the playing field and several robots in action, visit [1]-[2].

TEAM 1000: THE CYBEARCATS

In the fall of 2002, Wheeler High School (WHS) in northwest Indiana decided to form a team to enter the FIRST competition. They had experience from participating in a robotic competition the year before, and a core of dedicated and qualified teachers were prepared to lead their team in this significant new endeavor. The team obtained the support of the students, parents, school board, and community before deciding to enter the competition.

The team sought sponsors from the community, and these requests were very well received. Many local businesses and individuals donated money for the team to purchase supplies and for travel expenses. Particular support came from Urschel Laboratories, a local manufacturer of precision cutting tools for the food processing industry. In addition to providing financial support, several local companies also provided technical assistance for the team.

The College of Engineering at Valparaiso University also agreed to provide technical assistance to the team, and several faculty and students have participated in the design process for the WHS robot.

The importance of this widespread community support cannot be overemphasized. Entry into the FIRST competition is somewhat expensive, with typical budgets for supplies and travel of approximately $10,000 per year for each team. Clearly, very few school districts could afford to support such a program without substantial external financial support. External technical support is also critical, as it is this interactions with professionals in science and engineering that will help students discover how interesting and rewarding such a career can be.

The WHS team was assigned team number 1000, and they named their team the Cybearcats, after the mascot of the school's sports teams, the Bearcats. [3]

LESSONS LEARNED

The six-week design and build phase of the project is extremely busy for all involved in the project. Although the team carefully laid out a Gantt chart showing the timing of

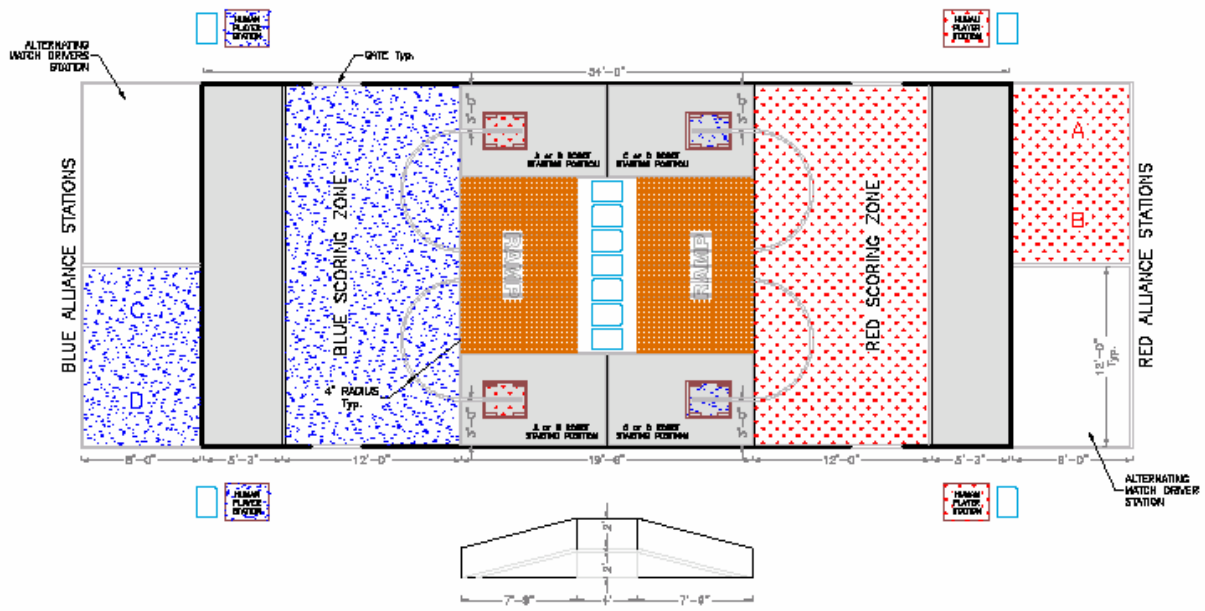

Figure 1. The playing field for the 2003 competition

all major design, build, and test deadlines, it was very difficult to maintain such a tight schedule.

It was particularly challenging to coordinate the efforts of teachers, students, and professional engineers from several different sites. As part of the project, we established an email listserv that could be used to distribute information to all team members by sending it to a single address. In future years, it would be better to send messages to this address more routinely to keep all team members updated on the team's progress and near-term future plans.

Since substantial parts of the kit are reused from year to year, it will benefit the team a great deal to become very familiar with the major drive train and electronic components well before the six-week design and build phase. This is one of the major reasons why veteran teams have a substantial benefit over rookie teams; their returning students and adult leaders bring back a great deal of experience from the previous year's competition.

It is very important to recruit adult leaders and sponsors with a variety of technical backgrounds. Most of the faculty involved in the project from Valparaiso University were from the departments of Electrical and Computer Engineering and Civil Engineering. Technical assistance in designing and fabricating the mechanical components of the robot would have been more effective if we had recruited participation from faculty in the Mechanical Engineering department, as well.

BENEFITS OF PARTICIPATING

There are several benefits to university faculty and students who participate in a FIRST robotics team [4]-[6]:

- Provides educational opportunities to volunteers who must learn as they help the students.
- Provides a first opportunity for college students to apply their engineering knowledge in a setting where they are the experts.
- Provides greater visibility for the university within the community.
- Serves as an opportunity for student organizations to provide community service.
- Develops creativity and teamwork skills among both students and faculty.
- Gives students an opportunity to operate under a firm deadline with no grade pressure.
- Provides opportunities for multidisciplinary interaction among students and faculty of all departments.
- Provides networking opportunity for college students who will soon enter the workforce.

And, most importantly,

- Promotes the fields of science and engineering to a group of high school students who are about to make a life-changing decision about their future career.

CONCLUSIONS

FIRST robotics is an incredibly demanding and simultaneously rewarding opportunity for university science and engineering faculty and students to interact with local high school students in designing, building, and testing a robot that will participate in a national competition. The deadlines for the competition are very tight, and it is essential to coordinate the team sponsors at various sites so that they can participate effectively with the team.

In spite of these challenges, sponsoring a FIRST team is a very rewarding experience, providing many opportunities for both students and faculty that would not be possible in a classroom setting.

REFERENCES

[1] http://robotics.nasa.gov/archive/video.htm

[2] http://www2.usfirst.org/2003comp/The_Game.pdf

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[5] http://www.asme.org/mechanicaladvantage/September2000/robotics.html

[6] http://www.usfirst.org/robotics/volbook/benefits.pdf