Robofest 2009

Motivating young minds to master the machine

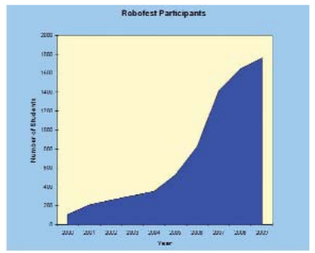
by Jamie MacLennan

Ever wanted to design a machine that would operate autonomously while showing off your creative side? Ever been curious about how computer programs are actually made and implemented? That's how I felt before I entered my first Robofest robotics competition, but little did I realize what an influence it would have on me. Before I share my story about my involvement with Robofest, let me tell you a little about Robofest itself—what it is and what it aims to accomplish.

Final round of the Game competition at the 2009 Robofest World Championship. Korean team SangSang won a decisive two rounds against Michigan team LEGO Raiders to capture first place.

ROBOFEST: SIMPLE PROGRAM—BIG RESULTS!

Robofest is a rapidly growing robotics competition that inspires middle and high school students from around the world to be creative and innovative while developing their understanding of science, technology, engineering and mathematics. Robofest provides a platform where students are motivated to learn new concepts in logic, mechanics, physics, electronics and computer programming so that they will be able to achieve their goals—goals that are fun, engaging, allow originality and instill the value of teamwork.



Robofest was founded in 2000 at Lawrence Technological University in Southfield, Michigan, and just over 100 students participated. Since then, it has expanded rapidly with over 1,700 students and 500 teams worldwide, including Canada, France, Korea, Thailand, Singapore and the United States.

The simplicity of Robofest makes it an educational program that is available and affordable for every student. Anyone can start a team anywhere with the little investment required to begin (often available from small local sponsors).

With minor exceptions, robotics kits of all types are allowed as are any additional materials. But every robot must be completely autonomous and meet the requirements of its specific category of competition. Any programming language is permitted, although icon-based languages such as NXT-G, RCX code, and RoboLab are recommended for the junior division (grades 5 through 8). Text-based languages such as C, Java and Basic are suggested for the senior division (grades 9 through 12) because they are more challenging and powerful. Materials for competition fields are also simple, inexpensive and readily available at local stores.

2009 World Robofest Championship winners of the U.S. Army's TARCEC Creativity and Innovation Grant.

PHOTOS COURTESY OF DR. CHAN-JIN CHUNG & ROBOFEST

COMPETITION FUELS THE FUN

Teams consisting of one to seven students are formed at local schools, home school groups, neighborhood clubs and community and civic organizations. Smaller teams for more hands-on opportunities for each student and have more flexibility in facilitating team meetings. Each team may compete in one of four categories: Games, Exhibition, RoboFashion and Dance Show and the Vision Centric Robot Challenge (more on this later).

A junior Game team solves the UPC.

Qualifying competitions at over 30 sites worldwide are held early in the year, and video submissions are allowed for teams that are not able to travel to qualifying sites. Top teams from this level are invited to the Regional Championships, which are held in April. Regional winners advance to the May Robofest World Championship on the campus of Lawrence Technological University in Southfield, Michigan. Certificates, medals and trophies are awarded liberally at all levels, and grants, robotics prizes and scholarships are awarded at the world event.

GAME COMPETITION

Perhaps the most exciting competition, especially for me, is the "Game" category (see "My Robofest Story"). Toward the end of each calendar year, the following year's "mission" is unveiled; exact details are given on what each robot must do to attain the highest possible score. Senior division teams are given a more challenging mission than junior division teams.

In a matter of weeks, teams must design, construct, program and test their robots to accomplish this mission in the most reliable way. Creativity and innovation shine through as every team approaches the mission from its own unique perspective. Although the most clever-looking inventions attract the most attention and tend to perform well, a surprisingly simple design often takes home the prize.

A Game competition team solves the Unknown Problem Challenge (UPC).

One of my favorite parts of the Game is the "Unknown Problem Challenge," or UPC. A vague description of the UPC is given when the mission is announced, but the specific details are not released until the day of the competition. Without their coaches' help, teams must use concepts they have mastered to solve the problem in a short time and then demonstrate their abilities with their robot. How well a team does on the UPC impacts their overall status in the competition.

EXHIBITION

The Exhibition category is an opportunity for students to integrate their inventive and creative ideas with robotics. There are no limitations on the type of project students can present. Some teams' projects are meant for entertainment; some might be marketable or even lead to further scientific research. Last year, the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC) provided Creativity and Innovation grants to top exhibition teams at the Robofest World Championship.

The 2009 first-place senior Exhibition winners were the Galactic Wailers. This team created sensor-operated musical instruments using NXT robots. Together, they played an arrangement of the "Star Wars" theme song using robots that resembled a keyboard, a violin and a stringed bass instrument.

The members of senior team Homemade Titanium researched landmines and designed SEEKER—a low-cost, lightweight, fully autonomous robot that searches for and marks the locations of landmines. They actually formed a company and filed for a patent for their entrepreneurial idea. It has the potential to save many lives in areas that cannot afford expensive technology to address this problem.

The top winner from the junior teams was Operation Chocolate—a team that designed a robotic system to make customized chocolate-covered pretzels. Their robots took customer input and then selected and dipped pretzels into melted chocolate and setting them out to cool. The aroma of this project attracted much attention in the exhibition halls.

The Cranbrook Bobbers developed a buoy that's equipped to sample water and test its quality. The Desert Eagles designed a miniature RoboRecycling facility with robots that loaded, transported and sorted a variety of colored objects. Team Tilt

Competitors face off during the World Robofest Game competition.

A junior Game team from Emerson Elementary in Detroit, Michigan.

designed a tilting board game with a maze and a ping-pong ball operated by a person sitting on an exercise ball. Accelerometers mounted on the ball provided inputs for the robot-controlled game board.

ROBOFASHION & DANCE SHOW

This allows teams two minutes for their robots to display their costumes and dance maneuvers on a small stage. Judging is based on criteria such as creativity, decoration, choreography and the math and science skills used.

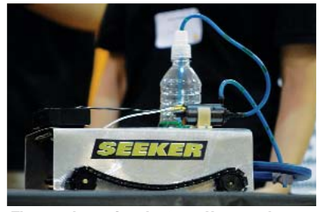
VISION CENTRIC ROBOT CHALLENGE

The Vision Centric Robot Challenge is for college students and gifted high school students. Teams may have one college student or up to three high school students. The robots used must be L2Bots—robots controlled by laptops mounted on top that are specially built for this challenge by Lawrence Tech.

Last year's challenge required that every team's robot follow a path inside two dashed lines using a Web camera. When the robots reached the "Dead End" sign at the end of the track, they had to turn around and return to their starting positions. The light conditions varied dramatically throughout the course and included a dark tunnel and a brightly lit area.

MY ROBOFEST STORY

When my friends and I formed an all-girls Robofest team three years ago, I thought it would be fun to spend time together building robots and learning how to program them. I had no idea how much I would become fascinated by the world of robotics or that it would encourage me to pursue a career in engineering.



The members of senior team Homemade Titanium from Clawson, Michigan, researched landmines and designed SEEKER—a lightweight, low-cost, fully autonomous robot that searches for and marks the locations of landmines.

A robotically controlled violin demonstrated by the Gallactic Wailers.

2007

My first taste Our first year, the challenge for the Game competition was to build and program two robots to navigate through a course using lines and landmarks, find and "rescue" foil-covered tennis balls and then bring the balls back to the robots' starting position. Since our team was relatively new to programming and working with robots, we spent most of our time experimenting with LEGO parts and programming software. I worked mainly on programming the robots while my two teammates focused on building them. Together, we discussed and tried a variety of ways of complete the mission.

Exhibition team Operation Chocolate explain their robotically controlled chocolate-dipped pretzel process.

By the time we competed four months later, we had two robots that were capable of collecting all the balls, but they did so unreliably. Our score was not high enough to advance in the competition, but we all learned perseverance and teamwork in addition to all we gained by designing and programming our first robots.

2008 BRING IT ON!

The following year, I joined my brother's team. Among the four of us, we had a builder and a programmer for each robot. The robots' mission was similar but offered new challenges: they had to find their way around obstacles and gather balls on a playing field marked with lines. Our team chose to have one robot collect the ball placed in the corner of the field and the other robot get the three balls that would be positioned randomly along a line in the center of the field.

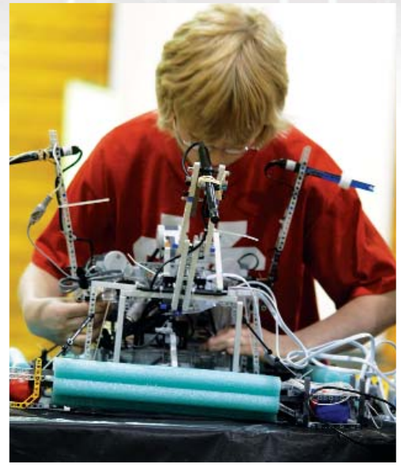
My job on our team was to program the robot that got the three balls positioned on the centerline. After my teammate had finished a robust design, I tackled the programming aspect. My biggest challenge was making the robot reliable enough to prevent its side arms knocking the balls out of the way as it was following the line. After much testing, experimentation and consulting with my knowledgeable coach, we dealt with this problem by tweaking the "smoothness" of the line-following program so that the robot would make smaller corrections to stay on the line.

On the robot's side, we added an arm with a trap door that would allow the ball to roll inside the robot's collector but not roll out if the robot turned back. To improve our reliability in collecting the balls, my teammate and I designed a powered wheel cage that would sweep any balls in front of the robot into the collector. Our second robot was designed by my other two teammates; it performed well and successfully retrieved the corner ball dependably except under unexpected light conditions. We were very excited when we won at our qualifying site and placed fourth at the World Championship!

2009

A notable finish The Game Competition was noticeably different in 2009. It involved matches between two teams; the game required individual robots to attempt to be the first to occupy an unknown zone on the playing field for five seconds or push the opposing robot off the playing field.

The Unknown Problem Challenge (UPC) was to draw a shape with the dimensions and number of sides that would be revealed on the day of the competition. Although we all exchanged ideas on the robot's development, the UPC was the aspect of the mission that became my main responsibility.



The Bobbers developed a water buoy with robotic water-sampling capabilities.

An L2Bot navigates the course for the Vision Centric Robot Challenge at the 2009 Robofest World Championship.

First, I designed a spring-loaded "pen" device that could be securely attached to the center of the robot. Then I determined how many revolutions the wheel motors had to turn for the wheels to make one complete revolution by dividing the distance between the drive wheels by the diameter of a wheel. Repeated testing allowed me to make this number more precise. Finally, I calculated how many revolutions the motors must make for every inch the robot traveled forwards or degree it turned.

At the World Championship, we were given two side lengths of a right triangle and then asked to draw it. Using trigonometry, we calculated the unknown angles and side length. Then we used the ratios we had previously found to make the robot turn at each precise angle and go forwards each exact length.

Meanwhile, our team's robot builder designed a gear-shifting mechanism that allowed the robot to travel with either high velocity or high power. This was very advantageous because the mission required both speed and strength. One of our programmers composed code for many scenarios,

RoboFashion and Dance Show world champion Robotics Top Dance Crew (RTDC) from Bloomfield Hills, Michigan, wowed the audience and the judges with their show.

and the other developed a distance sensor to detect the opposing robot with absolute precision. Our team placed first at our qualifying site and third at the World Championship, and our drawing was judged as the best at both sites.

A VISION FOR THE FUTURE

Learning mechanical design and basic programming skills by participating in Robofest was so intriguing and enjoyable that it was one of the most important factors that influenced my decision to choose an engineering major. Now I am a freshman mechanical engineering student at Lawrence Technological University, where I also work as a Robotics Lab Assistant for the Autonomous Robotics Institute for Students and Educators. I am considering a second major in computer science and mathematics to enhance my ability to apply intelligent robotics to other interesting fields.

I was inspired to develop creative and technical skills by actually building, programming and competing with our team robots, and for me, that makes Robofest an unforgettable experience.

Links
Robofest, www.robofest.net

Lawrence Technological University, www.ltu.edu

For more information, please see our source guide on page ___.

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