

by Professor CJ Chung

THE GLOBAL ROBOTICS ART FESTIVAL (GRAF)

Robotics Artistry Through STEM

Robotics, especially computer programmed autonomous robotics, is all about science, technology, engineering and math (STEM). The art in our Festival is tightly connected to each of the STEM components. The idea of the Global Robotics Art Festival (GRAF) is based on our experience from Robofest, see www.robofest.net, as described in the January – February 2014 issue of Robot. The concept is to integrate arts with robotics to provide effective and interdisciplinary STEM learning environments where students will have an unforgettable fun experience by creating robotics art projects using a universal language, art. The goals of GRAF are to attract more students to pursue STEM fields, to prepare them to excel in advanced education, and to promote creativity.

GRAF has visual and performing robotic arts categories open to student teams from 4th through 12th grade. Suggested examples of visual robotic arts include interactive kinetic sculptures, kinetic canvases, and robotic painters

(robots that draw). Examples of performing robotic arts include a robot dancer, a group of robot dancers that synchronize their moves, a robot fashion show, robot-skits, robots that play music, and robotic musical instruments that can be played by humans or that help humans play music. Robots must have computational components programmed by students and must integrate sensors.

GRAF 2013 TEAM PROJECTS AND WINNING TEAMS

The inaugural GRAF (Global Robotics Art Festival) event was held on November 23 at Macomb Community College, Warren, Michigan. Two registered teams dropped out, but a total of 39 students in 13 teams came from Michigan, Ohio, Canada, and Mexico. 79% were young students in either elementary or middle school. 28% of the participants were female students, which is far higher than the female student participation rate (approximately 15%), in college engineering programs. Average team size

Robot guitar and six-finger robotic piano player



Team Five
One robot

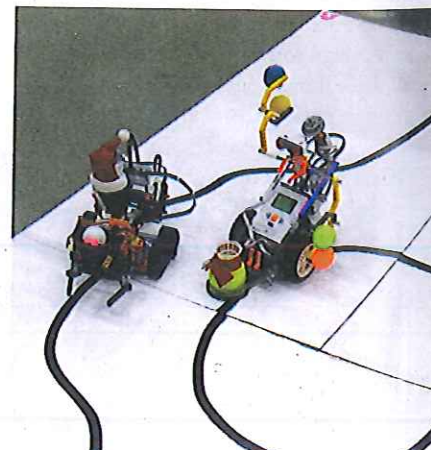
was three, which provides an ideal learning environment to develop both independence and collaboration for the problem-based learning paradigm.

More students were interested in the visual arts category. 62% of teams chose visual arts robotics projects, while 38% chose music, dance, or play related projects. One team combined both visual and performing arts aspects. Twelve judges selected the champion robotic artists in the visual and performing robotic arts categories.

Team Courageous 1 introduced a piano playing robot and a robotic guitar instrument. The piano robot had a creative mechanism with three motors that controlled six fingers. The guitar robot made different tones while sensing the finger location with an infrared distance sensor. 91.7 FM Ann Arbor, a part of the NPR (National Public Radio) digital network,



Lawrence Tech Department of Math and Computer Science, Professor Jon Ruzsala, developed a robotic kinetic sculpture with 10 golf balls hung on strings and controlled by an Arduino, which display various mathematically artistic patterns.



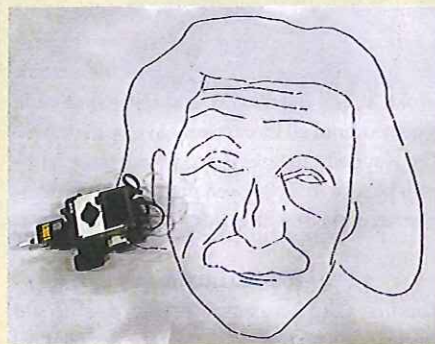
The Creative Canucks Dance Team created two robots in a play with a winter theme. The team narrated while the robots performed and danced. This team won a Judge's Choice award.

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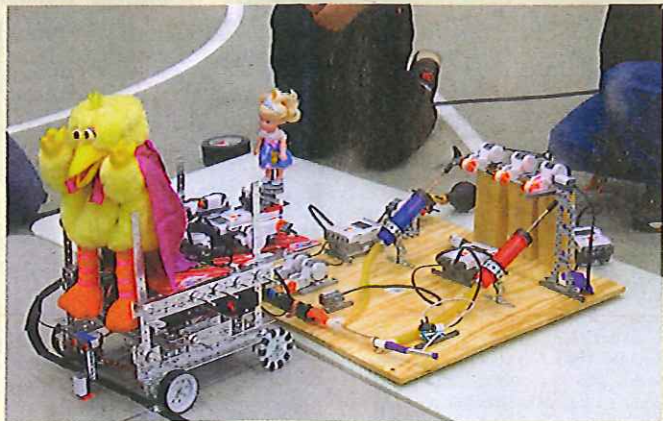
Team Five Girls' robotics art project included two robots that were programmed like they were in a band. One robot moved as if it were playing the guitar and the other one moved as if playing drums.



Lauro Ojeda, Department of Mechanical Engineering at University of Michigan, Ann Arbor, programmed Lego EV3 robot to draw pictures like this Einstein portrait.



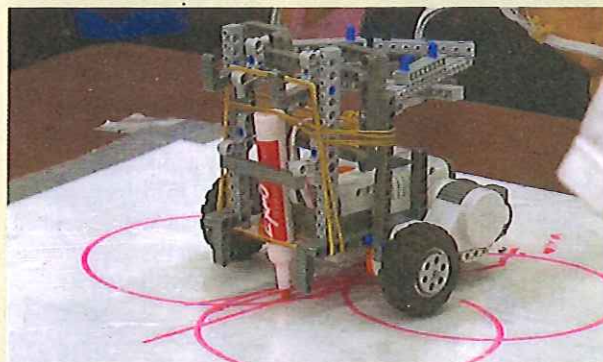
Above and below right: Team RoboCruisers introduced what they believed to be the world's first robot playing a recorder. Three motors were synchronized to control two pumps that provided air to play the recorder. When the robot was playing "Mary had a Little Lamb" on a recorder, the other robot duck was dancing to the music synchronized by Bluetooth signals. This team won first place in the junior division Performing Arts category.



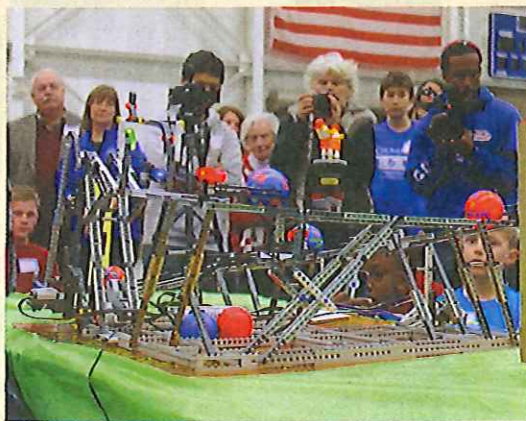
Team The Supernovas created a robot, Franc, which is designed to paint letters based on pre-entered coordinates. Franc painted the official logo for the Global Robotics Art Festival (GRAF). This team won first place in Junior Visual Arts category. The official GRAF logo was painted by the robot.

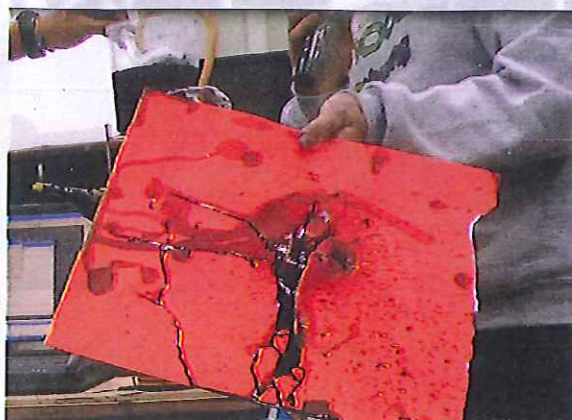


Left: Team GrafCraft designed a robot that could draw various shapes. It was programmed to draw circles, triangles and squares, and could also draw them in a repeating pattern.



Below: Team Courageous 3 created a kinetic art project called Cyclone II with balls on roller coasters moving through tracks. When a color ball was detected by the robot, it moved the ball up high.





Team Moodpainter developed a robot system with a database that will draw a shape by spraying different color paint according to a person's mood as determined by the music played on a foot keyboard. This team won first place in the Senior Visual Art category.



Team Courageous.

aired a part of "Jingle Bells" that the robots played. This team won first place in the senior division Performing Arts category.

Team Spruce Goose made a mechanical kinetic sculpture that abstractly depicts a cam shaft, in an artistic way, playing a LED light show activated by IR distance sensors. This team won Judge's Choice Award. Team Technocrats' project was kinetic arts where balls went down a Lego track and were picked up by a moving rotating arm. There were multiple balls on at once, so the effect was like moving art.

PROFESSIONAL ART ROBOTICS

Lauro Ojeda, Department of Mechanical Engineering at University of Michigan, Ann



In addition to K-12 student projects, attendees and spectators had chances to see some professional robotics arts projects. Fanuc Robotics brought a robotic arm that draws the Robofest mascot on plastic cups. See figures 19 and 20.

Arbor, developed this Lego EV3 robot to plot any picture. The program commands the robot to move to the first waypoint. Once it reaches its destination, the robot lowers the marker until it touches the floor. From this point, the robot will follow each subsequent waypoint that forms the stroke. When the program reaches the last waypoint of the current stroke, it lifts the marker and the sequence is repeated until all the strokes have been drawn. The waypoint dataset is acquired from a reference picture that has been pre-stored. He demonstrated the drawing of Einstein.

CONCLUSION

The first GRAF accomplished its goal to get students to pursue their interest in science, technology, engineering and math, known as the STEM subjects, by using the power of universal human interest in arts. Student projects show hands-on application of STEM and computing subjects to creative robotics arts projects that require problem-solving skills. We also learned, as Gullatt argues, that arts are not only for self-expression, but also for discovery. Involvement in arts promotes and develops creativity, and students feel a sense of beauty and joy. Participation data show that the inaugural GRAF has resulted in bringing more female and young students



Lawrence Tech Department of Math and Computer Science, Prof. Emily Trudell, programmed AIBO robot dogs to dance to the music and drew a lot of attention. A leader dog was sending Wi-Fi messages to the other two dogs to synchronize dance movements.

into STEM learning compared to students just participating in Robofest competitions. Since robotics art is a typical example of STEAM, GRAF is a perfect STREAM environment, adding R (Robotics) to STEAM. The second Annual GRAF event will be held in Michigan, tentatively in late October 2014.

SPONSORS

The inaugural GRAF was sponsored by Lawrence Technological University, Macomb Community College, and Robofest 2013 major sponsors - ROBOTIS Inc., National Defense Industry Association Michigan Chapter, DENSO, Lego Education, MI Council of Women in Technology Foundation, IEEE Southeast Michigan Section and Region 4, RobotC, RIIS, TOYOTA, Realtime Technologies, and mindsensors.com. ©

Editor's note: Author CJ Chung is Professor, Department of Mathematics and Computer Science, Lawrence Technological University; and Founder and Director of Robofest and RoboParade competitions. He can be contacted at cchung@LTU.edu.

Links
Robofest, www.robofest.net

For more information, please see our source guide on page 80.



Team ALL2JESUS created a robot that displays kinetic art patterns by using 16 servo motors and distance sensors. The robot changes the pattern either whenever it detects a new spectator or by using a built-in timer. This team won a Judge's Choice award.

DESIGN AN UNDERWATER ROVER

BOTBRAWL COMBAT

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ROBOT

THE LATEST IN HOBBY, SCIENCE AND COMBAT ROBOTICS

**VIDEO
GAME
BOTS**

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FEMISAPIEN!

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**EXPLORE THE
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JAMECO J-BOT

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MEET AND GREET BOT

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**PATROL
YOUR HOME!**
**PARALLAX
ACTIVITY BOT**

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