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▶ ROBOTICS Continued from G1

# Testing is a crucial step in robot-building

piece of aluminum we can cut and bolt down to see if this floor actually works. We've got to test out this theory."

Mangum's instructions send Holloway and the other team members scurrying — some to work on the floor of the robot's lifting and dumping mechanism — others to put the finishing touches on its conveyor belt.

Both components will play critical roles in the demanding game of "Lunacy" — which requires each self-propelled robot to traverse a slippery, ultra-low friction floor while picking up balls and tossing them into their opponents' trailers.

Solving the resulting set of design and engineering problems is a tedious, time-consuming and complicated process — and sometimes it's not very pretty. The robot room fills with groans, in fact, when Holloway and the rest of his team finally put their lifting floor to the test — only to find that it won't climb all the way up through the shifting, out-of-whack frame that holds it.

"One bang from another robot and this is going to bind up even more," says James Young, a retired NASA systems engineer who's logged five years as a team mentor.

"So no matter what you use to build this, it's got to be all squared up or it's not going to work."

Over at a nearby work bench, Juliana Wu, 16, and James Burton, 18, are having far better luck modifying the crucial conveyor belt that will carry the balls up from the floor and into the robot's hopper.

They've just replaced a straight brace spanning the middle of the mechanism's frame with a far stronger yet lighter set of cross members.

"This thing will see a lot of action in the competitions," Mangum tells his charges. "So it could bend and twist — and maybe stop altogether — if we don't make the right adjustments."

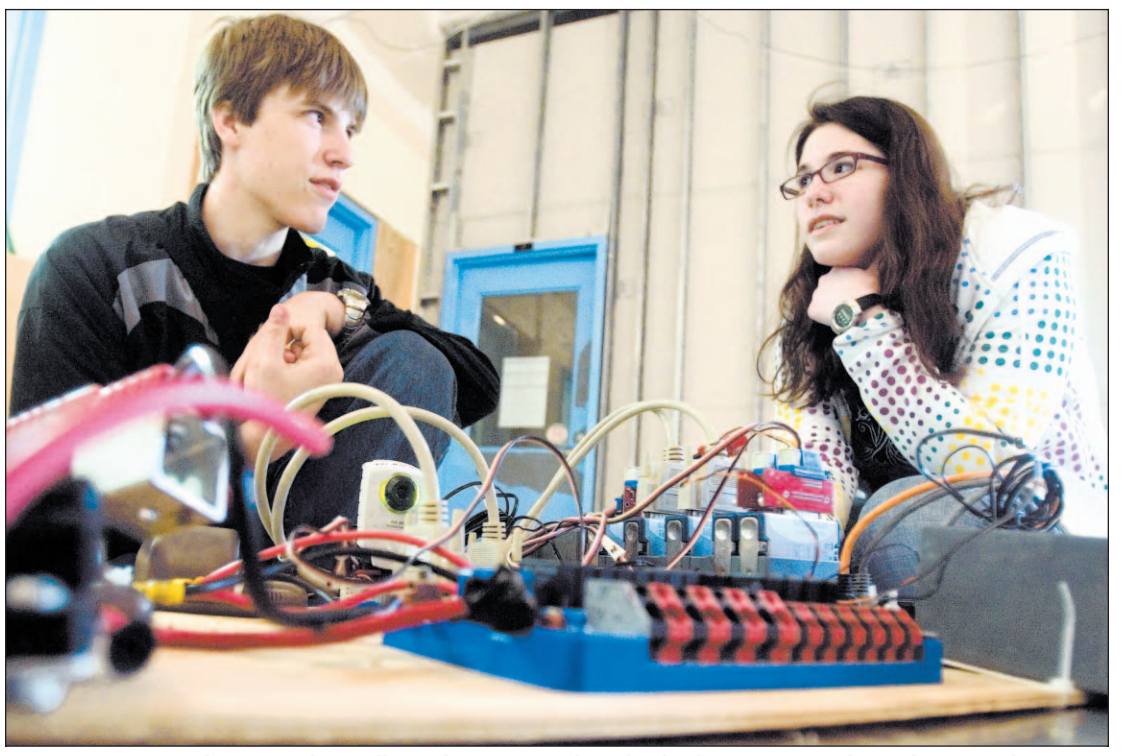
Such changes are just the latest in a long chain of design and engineering tweaks that have made the robot simpler and more robust since the team began working on the project in early January.

Since that time, they've built, tested and decided they didn't need a front-mounted brush roller to help scoop up the balls. They've also sized and resized the robot's hopper, then added a declining floor that should make it easier to for them to dump those balls into their opponents' trailers.

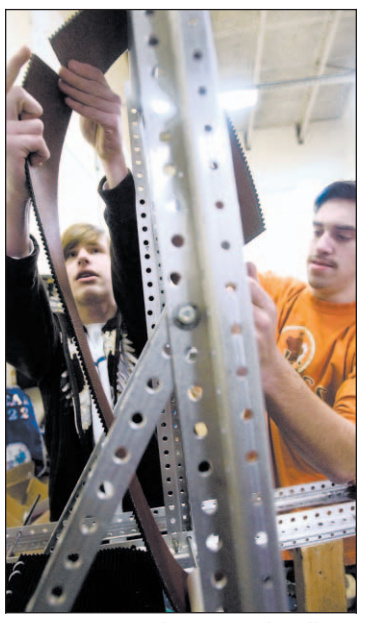
"We've seen teams go into an event with an untested robot and have to cut things off because they didn't work the way they thought they would," team leader Joanne Talmage says.

"So we're trying to avoid those last-minute problems by prototyping and testing them out."


**Team 122 team members Julia Thompson and David Holloway work at the New Horizons Regional Education Center in Hampton.** PHOTOS BY DIANE CEBULA/DAILY PRESS



**Team 122 mentor Chris McMahon talks with team member Elizabeth Murray, 16, about the control system. McMahon is currently a student at Thomas Nelson Community College but was a member of the team for two years.**



**Team 122 members David Holloway, 15, and Lawrence Agee, 17, work on making a conveyor belt system for the robot.**

**Online extra**

Go to www.team122.org to learn more about the NASA Knights and the 2009 FIRST Robotics competition. You can also go to dailypress.com/robotics for video of the team's progress.

**Editor's note**

This is the second in an occasional series of stories following the NASA Knights robotics team as they create a robot for the 2009 FIRST Robotics competitions.

Down the hallway in a glass-walled lair, the programming group is hard at work, too, trying to perfect the computer commands designed to make all the robot's sensors, motors, controllers and other electronic gear perform as the should.

But when they tested their chains of code with a demonstration robot on a super-slick floor made of fiberglass-reinforced polyester panels, the 4-wheeled base unit accelerated, slipped and steered erratically, threatening to spin out of control.

"It's not as bad as it looks," says Smithfield High School student Michael Filliater, 16, playing back a video of a recent test run on his Blackberry. "We've just had a lot of problems with the accelerometer."

"And now it's slipping a lot less," adds Calvin Winkowski, 16, of Grafton High School. "We're starting to get a feel for how it moves on that surface."

Still, the real test will have to wait until the fabrication team completes the competition robot — and all the delays spawned by the design changes of the past few weeks are making the programmers nervous.

With the deadline for completion fast approaching, the mentors are starting to show a little strain, too. The next two Saturdays, they say, will be long, make-or-break workdays that could determine how well the award-winning team and its robot will do in the competitions this year.

"It's a big-time commitment for all of us," Mangum says, counting the hours that 40-odd kids and about a dozen mentors have devoted to this year's project.

"But look at the experiences they're getting. If something like this had existed when I was growing up, I would have done this instead of automotives."

# Handy student is trying to make the world safer

*A Virginia Tech student from Poquoson is climbing high in the world of cutting-edge robotics.*

BY SAM MCDONALD
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It's no exaggeration to call 23-year-old Nick Thayer a robot master of international distinction.

Late last year, Thayer —a Virginia Tech graduate student from Poquoson — traveled to Seoul, South Korea, where he introduced a robot named CIRCA at the International Capstone Design Fair.

CIRCA — along with its robotic brothers HyDRAS-Ascent and HyDRAS-Ascent II — won the fair's grand prize, earning glory for Virginia Tech and a sudden surge of fame for the machine's young wrangler.

Since his return from Korea, Popular Science magazine and the Discovery Channel have taken an interest in the mechanized marvels developed by the robotics team at Virginia Tech.

Thayer has become a hot property.

"People have been calling from all over the place and people are trying to give me professional advice. My dad says, 'This is a career changer.' But this is all new to me. It's great, but new."

Does he feel like a celebrity?

"A little bit. It feels good."

Mechanical engineers aren't often showered with this kind of media attention. Thayer and his associates in Blacksburg have created something that's clearly buzzworthy. Their innovations, while not sexy to the eye, hold potential to save human lives.

Researchers and students at Tech's Robotics and Mechanisms Laboratory — RoMeLa for short — have developed a set of pole-climbing serpentine robots. Ultimately, they hope their machines will be capable of conducting bridge inspections and other similar tasks that are dangerous for people.

The key to the robot's climbing ability comes from a type of movement called nutation. "This is a motion not found in nature, no animal uses this motion," Thayer said.

A series of segments able to contract like muscles are linked together to create a strand. Through carefully timed contractions, the strand can wrap around and shimmy up a pole such as a bridge support.

"It can wiggle around a pole like a snake," Thayer said, explaining that CIRCA uses compressed air to power its climbing muscles. "The main purpose is to climb poles, climb scaffolding to inspect for defects or cracks," he said. "Construction deaths caused by falling from high places have increased. This is something that could remedy that."


**Gabriel Goldman, left, and Nick Thayer, right, accept design awards from Jun-Hyung Rho, president of Seoul National University of Technology.** PHOTO COURTESY OF VIRGINIA TECH

Dennis Hong, the director of Virginia Tech's robotics lab, sees a bright future for the creations.

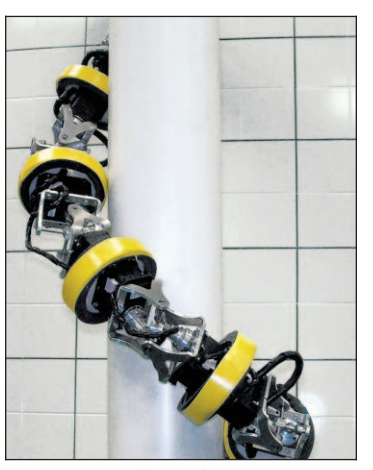
"In robotics, we try to build machines to take care of the Three Ds: Tasks that are dirty, dangerous and dull. And I would add a fourth, difficult," Hong said. He said that CIRCA (which stands for Climbing Inspection Robot with Compressed Air) and HyDRAS (Hyper-redundant Discrete Robotic Articulated Serpentine) will tackle big tasks like bridge inspections first. Eventually, though, he hopes they'll take on tiny challenges. "Going into the future, I'm envisioning robots that are really small, the diameter of a pencil," he said. "They'll be snake-like robots that do not use electricity or rigid metal parts. Think licorice, but it moves around."

Those robots would be useful in medical applications, like endoscopes. "We're working on that right now," he said.

Hong described Thayer as a valuable member of the RoMeLa team.

"He's really passionate, his initiative is the highest," said Hong. "That passion and initiative leads to many different things. He's a team player. He's also good at making things. He has device-making skills, a hands-on approach."

Ironically, those hands-on tasks — not text books — helped Thayer find success in academia.



**HyDRAS, a robot whose name stands for Hyper-redundant Discrete Robotic Articulated Serpentine for climbing, is able to crawl up a pole by converting the oscillating motion of its joints to a whole-body rolling motion.**

**News to Use**

To learn more about the robotics innovations taking place at the Virginia Tech robotics lab, visit www.me.vt.edu/romela

"In high school, I was not totally dedicated," Thayer admitted. "Most of my memories are from track or cross country. I hung out with my friends a lot. My physics teacher was also my cross country coach. I really enjoyed that."

While he was fascinated by mechanics, he didn't explore the subject until much later. "Once in college, I started tinkering. I started working with cars, anything mechanical."

Likewise, after he earned an undergraduate engineering degree at Virginia Tech, it was not his grades but his accomplishments in the lab that helped him move forward. He's now pursuing a doctorate in robotics.

"The problem was, I never had fantastic grades," Thayer said. "They weren't bad, but not strong enough for grad school. My research and design project was what got me into grad school."

But back at Poquoson High School, Thayer's running coach and physics teacher said he wasn't at all surprised that his former pupil has climbed to such heights.

"He's the kind of kid who worked really hard for everything he got," said teacher Joe Garrity. "I think he enjoys learning, and he's not grade-driven. He wants to understand things, and understand them on his own terms. It was the same thing in track and cross country. He set goals he set for himself, and he was determined to reach them. There's no stopping a guy like that."

Who's most excited about the student's recent triumphs?

His grandparents, Thayer said. "They call every week and say, 'Hey, smarty pants.' "