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WPI RESEARCH

DISCOVERY & INNOVATION WITH PURPOSE

DECEMBER 2023 ISSUE

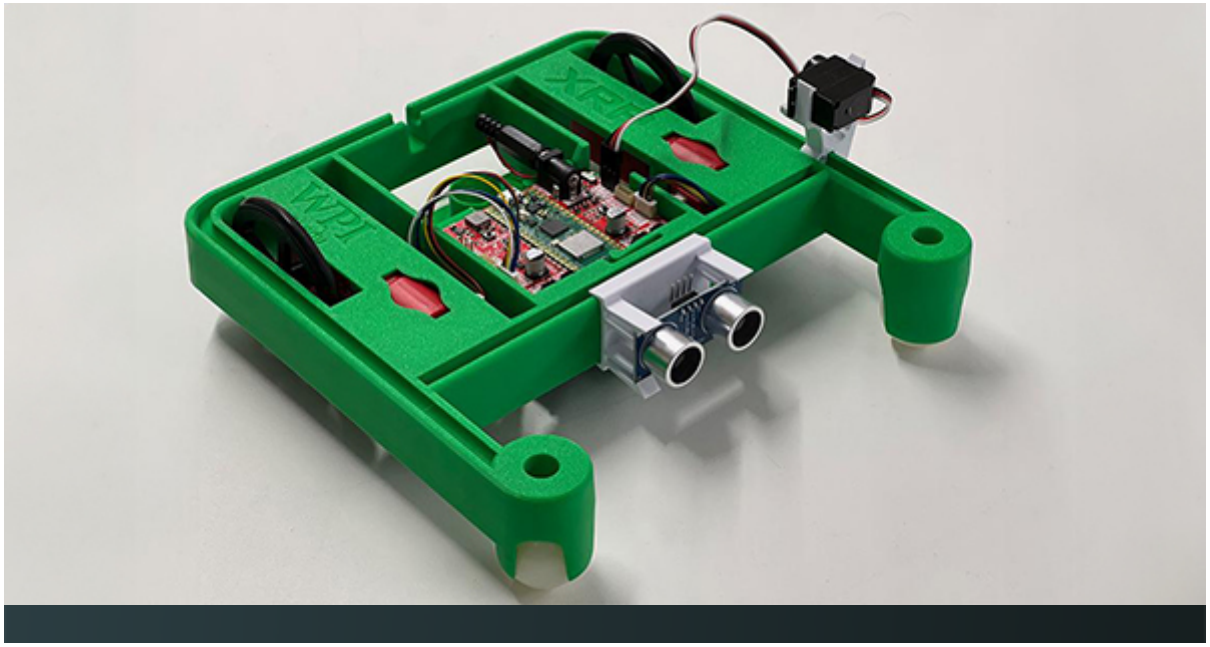
Happy Holidays from WPI!

Discover the cheer a year at WPI brings, along with 23 of the top moments at WPI from 2023. The holiday season means many things to those who celebrate it. We hope that, whatever your traditions, you enjoy a season of peace, love, laughter, joy, and gratitude.

WPI Establishes Master's Degree in Artificial Intelligence

WPI has launched a BS/MS, MS, and graduate certificate program that builds on its expertise in artificial intelligence (AI). AI is an umbrella term for machines or computer systems that perform tasks that typically require human intelligence or mimic human behavior. The field of AI is rapidly expanding, creating an increasing demand for knowledgeable professionals. AI is a strategic research area for WPI, with faculty and students focused on the application of AI in health, learning sciences, game development, robotics, engineering, business, and global sustainability. Nearly every area of research is touched by AI, whether as a focus of inquiry or an applicable tool.

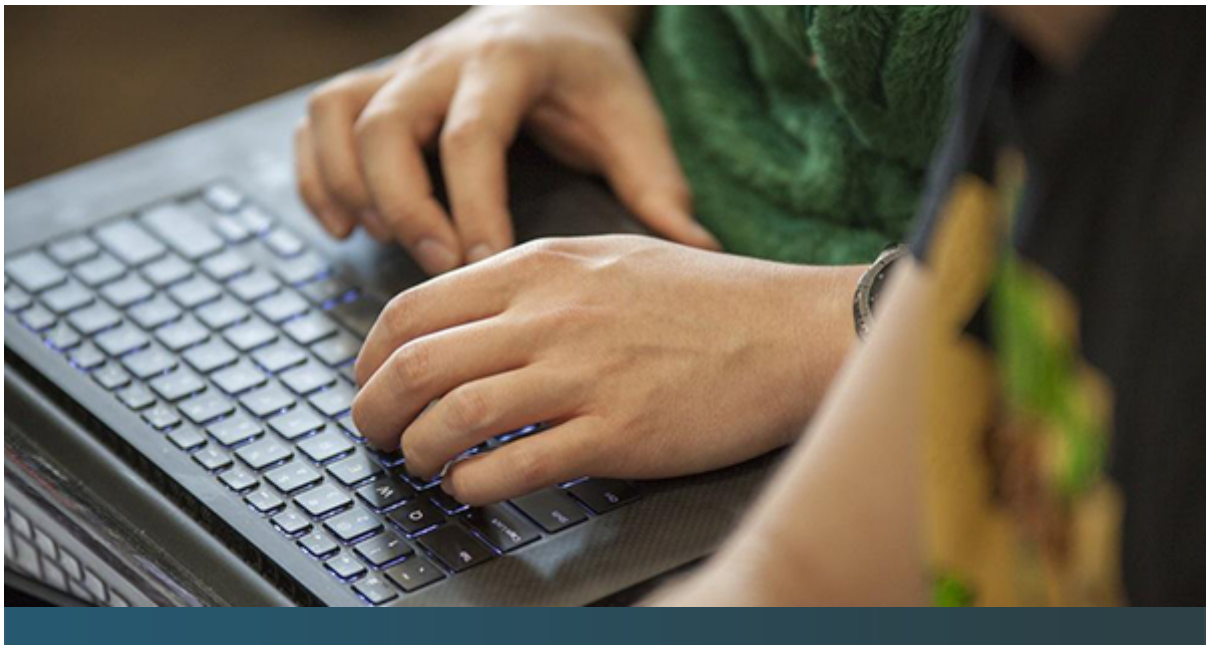
Read the full story →



Open-Source Robotics Platform Expands Its Reach

One year after the XRP (Experiential Robotics Platform) debuted at the *2022 FIRST Global Challenge* in Switzerland, demand for and distribution of the platform—which is revolutionizing robotics engineering and helping democratize global STEM access—has continued to expand. Partnering with various organizations for production and distribution, the XRP is being used in high school and college STEM courses, and hobbyist makers are purchasing units. Design innovations of the XRP at WPI have resulted in a simpler, single-piece chassis, which allows users to spend less time constructing the robot before they start programming.

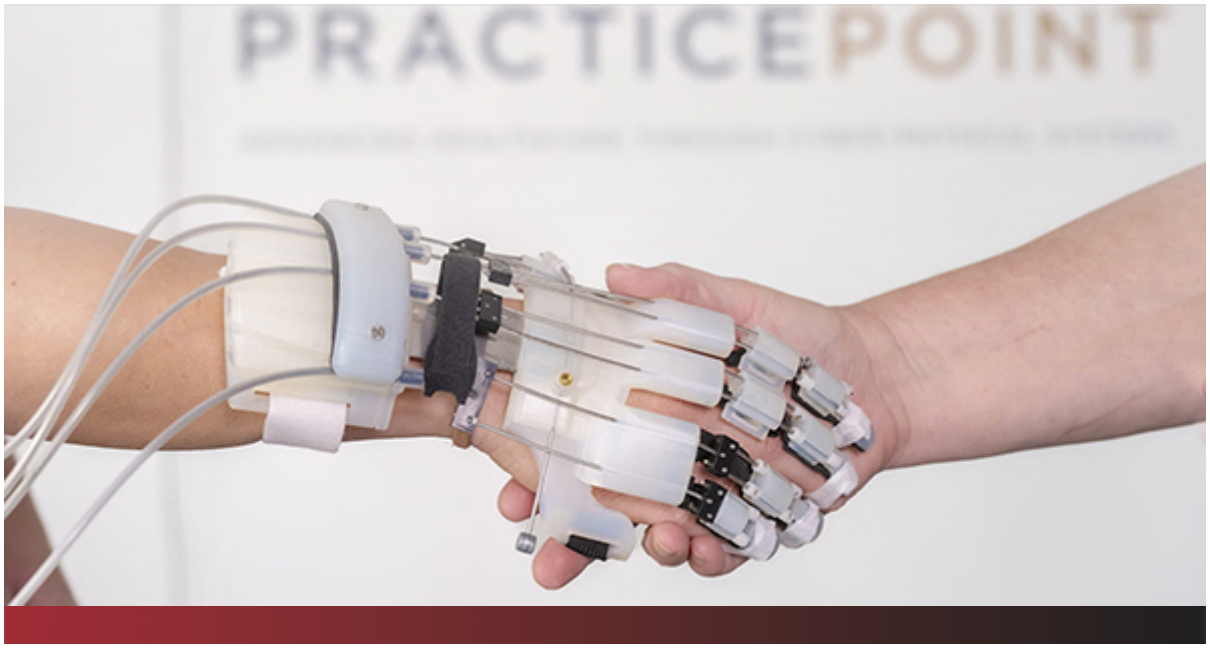
Read the full story →



Grant Supports Programs for Low-Income Students and Research Opportunities

The National Science Foundation has awarded a $2.5 million six-year grant to WPI to boost enrollment, retention, and graduation of low-income computer science students by funding scholarships, mentoring, and support programs. Computer Science Professor of Teaching Rodica Neamtu is the principal investigator (PI) on the grant; co-PIs are Assistant Dean of Undergraduate Studies Debra Boucher and Assistant Professor of Social Science and Policy Studies Crystal Brown. The project will study interventions to determine how to boost the retention and timely graduation of Pell-eligible students, which may be useful to other departments in the future.

Read the full story →



The Humanity of Robots in the Workplace

As WPI researchers introduce innovative robotic solutions into entirely new workplace environments, understanding how humans interact, appreciate, and accept these high-tech coworkers takes on greater significance in the quest to harness the strengths of both. In the Fall 2023 WPI Journal, read how robots are working alongside humans to reinforce the skills of physical therapists, explore inaccessible areas, complete tedious and physically demanding work, and shoulder dangerous tasks—real-life examples of how robots are essential tools in a high-tech, hybrid workplace of the future.

Read the full story →

MEDIA COVERAGE

[Fire Protection Engineering Students Demonstrate Christmas Tree Fire Dangers—*Spectrum News 1*]

Spectrum News 1 spoke with WPI fire protection engineering students who demonstrated in a laboratory how quickly Christmas trees can burn. The demonstration showed the difference in ignition time for a dried-out tree and one that has been consistently watered. Fire Protection

Engineering Professor Albert Simeoni commented that a properly watered tree that catches fire burns more slowly than a dry tree, thus giving people more time to escape the fire. This demonstration aimed to increase awareness of tree fire risks. This story was also covered by *Boston 25 News* and *The Worcester Guardian* .

[Marketing Professor Offers Insight on Holiday Gift Spending—*USA Today*]

Assistant Professor of Marketing in The Business School Farnoush Reshadi spoke with *USA Today* to share her expertise on personal finance and gift giving, such as keeping to a budget during the holiday season and how to be a better gift giver. Rather than wasting money on a gift someone doesn't want, Reshadi suggested gift givers should focus on practical items recipients can use, citing that, on average, people waste $71 on gifts no one wants. She also said recipients prefer less costly gifts because people "don't want to feel indebted to you by receiving an expensive gift."

[Cities Expand Sustainability Efforts—*American City & County*]

Stephen McCauley, professor in the department of Integrative & Global Studies, offered analysis and recommendations to *American City & County* on how municipalities can become more sustainable. He discussed the benefits of increasing micro transportation, expanding electric vehicle charging infrastructure, and developing sustainability plans with robust community outreach. McCauley predicts that cities will plant more trees in urban spaces and use more artificial intelligence. Cities and counties can achieve sustainability goals in the near future, he said, by creating more "green space" throughout the region. McCauley's research has focused on climate resilience, including mapping heat islands in the city of Worcester.

[Super Apps as Possible Next "Big Thing" for Enterprise IT—*ComputerWorld*]

Professor and Department Head of Computer Science Craig Shue spoke with *ComputerWorld* about all-in-one mobile apps that combine multiple mini apps and services under a single platform. He discussed organizations' worries about vendor dependency if they utilize these mobile apps. "Organizations that decide to work with vendors should be

wary of vendor lock-in," Shue said. "Once an organization licenses an app and begins using it, they may grow dependent upon it. This puts them at a disadvantage should they ever want to leave that application's ecosystem."

Know someone who would love to hear about WPI's research?

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WPI Establishes Master's Degree in Artificial Intelligence to Prepare Students for Growing Field

Program Builds on WPI's Expertise in AI; Will Offer MS, BS/MS, and Graduate Certificate Degrees

Media Contact
Steven Foskett
Public Relations Manager
Marketing Communications
media@wpi.edu

December 13, 2023

To help meet the demand for professionals with expertise in the rapidly evolving field of artificial intelligence (AI), Worcester Polytechnic Institute (WPI) has launched a new degree program in AI that will offer students the opportunity to earn a master's degree, a combined bachelor's/master's degree, or a graduate certificate through courses, projects, and thesis work. The program will leverage the university's extensive experience in research and project-based education in AI to provide students with the technical skills and ethical understanding needed for careers in industry, government, and academia.

WPI will offer students flexible, yet highly rigorous, areas of specialization with courses on subjects ranging from deep learning to generative AI. The program will combine theory and practice to train students in the understanding, development, deployment, and innovation of AI techniques and systems. Students also will study AI in an interdisciplinary way, with options to take courses offered by the School of Arts & Sciences, the School of Engineering, and the Business School. An important distinction of WPI's program is a strong emphasis on the societal and ethical implications of AI.

"WPI has long led higher education as a place where students and faculty have used AI and project-based learning to tackle big challenges in healthcare, justice, manufacturing, the environment, and other fields," said Jean King, Peterson Family Dean of WPI's School of Arts & Sciences. "We are excited to focus our AI strengths into this new program, which will prepare students for leadership roles in a transformational field that faces a critical shortage of qualified professionals."

> **"WPI has long led higher education as a place where students and faculty have used AI and project-based learning to tackle big challenges in healthcare, justice, manufacturing, the environment, and other fields. "We are excited to focus our AI strengths into this new program."**
>
> **Jean King, Peterson Family Dean of WPI's School of Arts & Sciences**

"The university is committed to continuing its leadership in a breadth of application areas for artificial intelligence technology," said John McNeill, the Bernard M. Gordon Dean of WPI's School of Engineering. "With the flexible nature of these AI offerings, students can tailor their program to the needs of many different career paths."

WPI's AI program will offer students the option to pursue three separate credentials:

- MS degree: Graduate students who have earned the equivalent of a four-year U.S. bachelor's degree in fields such as computer science, data science, mathematics, statistics, electrical and robotics engineering, information technology, business analytics, quantitative sciences or other related fields will be able to earn a degree by completing a total of 30 credit hours of work, including a thesis or capstone project.

- Combined BS/MS degree: WPI undergraduates will be able to pursue two degrees at an accelerated pace–a bachelor's degree in any major offered at WPI and an MS in AI–by double-counting certain courses toward both degrees. This option will allow students to pursue two degrees in less time than would typically be required to pursue each degree separately.

- Graduate Certificate: This option will prepare students to use AI technologies in real-world applications by completing four thematically related graduate courses in AI. These courses can be used as part of the MS degree in AI, if desired.

> **“With the flexible nature of these AI offerings, students can tailor their program to the needs of many different career paths.”**
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> **John McNeill, the Bernard M. Gordon Dean of WPI's School of Engineering**

AI is an umbrella term for machines or computer systems that can perform tasks that typically require human intelligence or mimic the behavior of humans. The development of WPI's new program coincides with a surge of demand for trained scientists and engineers who can apply AI techniques and tools. Industries ranging from technology, healthcare, finance, and manufacturing are actively seeking AI talent to harness the benefits of AI-driven solutions and innovations. The U.S. Bureau of Labor Statistics (BLS) projects an average of about 377,500 job openings annually in computer and information technology occupations through 2032. Median annual wages in 2022 for computer and information research scientists were $136,620, according to the BLS, and the consulting and accounting firm PwC estimated in its 2023 Global Investor survey that AI will contribute $15.7 trillion to the global economy by 2030.

“AI is transforming existing disciplines, giving rise to new industries, and reshaping the workplace,” said Elke Rundensteiner, the William Smith Dean's Professor of Computer Science and founding head of the WPI Data Science Program. “Our curriculum, faculty, and research at WPI make the university well positioned to prepare students to both advance AI techniques and apply them to science, engineering, medicine, automation, and other industries for economic growth and the betterment of society.”

AI also is a strategic research area for WPI, with faculty and students focused on the application of AI in health, learning sciences, game development, robotics, engineering, business, and global sustainability. Nearly every area of research is touched by AI, whether as a focus of inquiry or an applicable tool. Generative AI, such as large learning models or neural network models, allows researchers to efficiently process and leverage vast quantities of textual data to answer pressing questions and generate new insights.

WPI will begin accepting applications immediately for program enrollment in fall 2024.

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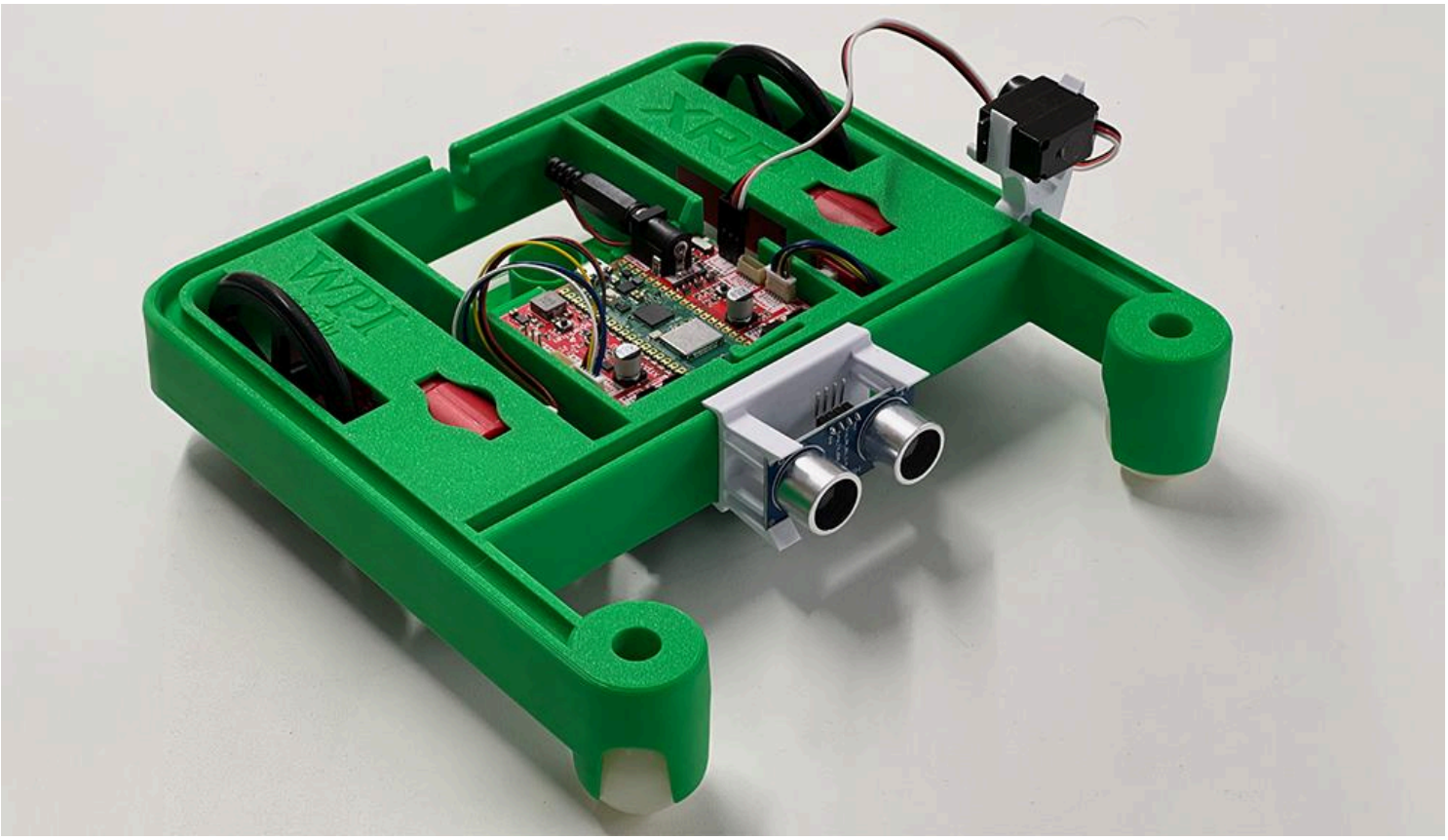


Open-Source Platform Transforming Robotics Engineering Education

A year after WPI helped debut XRP, device in use in classrooms and workshops around the world

▶ LISTEN 00:00

November 28, 2023

BY: MIA LUMSDEN

It's been a year since young roboticists from around the world were introduced to the small open-source device that could revolutionize robotics engineering and help democratize global STEM access. And what a year it's been.

During the 2022 *FIRST* Global Challenge in Geneva, Switzerland, WPI and DEKA Research & Development Corp. distributed nearly 200 beta versions of the Experiential Robotics Platform (XRP), a kit that makes it possible for novice engineers to build and program a simple, powerful, and affordable robot. The small but mighty device even caught the eye of music superstar will.i.am, a staunch STEM supporter who attended the event.

"We started with the idea that we would create this prototype for an open-source engineering education platform," says DEKA chief development officer David Rogers, who worked hand in hand with WPI's Brad Miller to debut the original XRP in 2022. Miller is a senior fellow with longtime experience collaborating with DEKA and *FIRST* Robotics through WPI's Robotics Resource Center. "In Geneva we got a lot of validation that this kind of product was something people were excited about."

Superstar will.i.am examines XRP during the 2022 FIRST Global Challenge.

The excitement surrounding XRP followed WPI folks back to the States and the project really took off. WPI and DEKA developed new partnerships with Raspberry Pi and ST Microelectronics to supply the microcontroller and the inertial measurement unit (IMU) chips, respectively, as well as with SparkFun Electronics to manufacture the electronics. And with DigiKey distributing finished devices to secondary schools, community colleges, and universities across the country, educators have begun integrating the XRP into STEM courses.

Officials from both DEKA, based in Manchester, N.H., and WPI are starting educational endeavors in their own backyards.

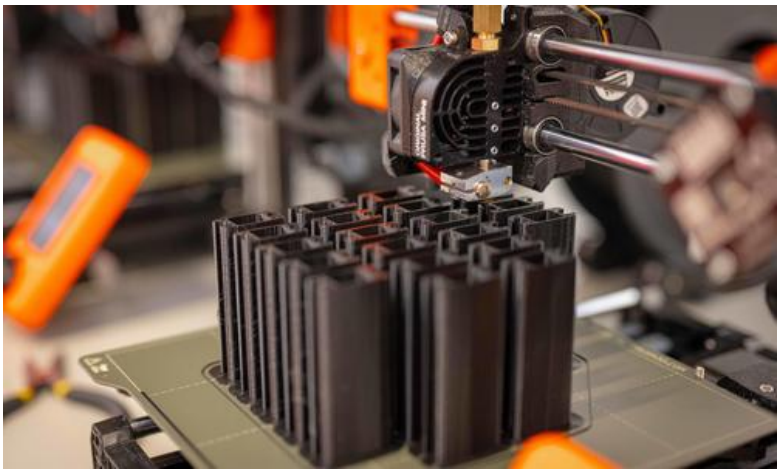
Thanks to a state grant, high school students at an engineering-focused charter school in Manchester are pioneering what Rogers calls a "community manufacturing concept." The principal at Spark Academy gave up his office so that teacher Dan Larochelle '95 could set up two dozen 3D printers, which students are using to manufacture XRPs that get shipped around the globe, all while getting valuable hands-on experience.

At the same time, *FIRST* New Hampshire is working with leading STEM educators from across the state to establish teacher training and professional development workshops centered around XRP. The external relations team at WPI is also exploring pilot programs with Worcester Public Schools.

"The XRP is leveling the playing field for STEM education and I'm proud that WPI is one of the founding partners of this project," says WPI President Grace Wang.

Makers outside the classroom are getting in on the action, too. Nearly 2,500 units have sold to hobbyists, educators, and suppliers since the commercial units went on the market in August, according to Dave Ortendahl, WPI's executive director of corporate partnerships, who is managing the university's role in this project.

The current version of the XRP looks and works much the same as the original kits, which were 3D-printed in WPI's Innovation Studio. Thanks to some design innovations that happened at WPI, however, the manufacturing is now much simpler. A single-piece chassis has replaced the original body made up of many separate parts, allowing users to spend less time constructing the unit before they start programming.



Parts for the beta XRP kits, 3D-printed at WPI.

That programming is key. It's the difference between building and engineering. It's also the part of the project where WPI's expertise lies, and Annie Hughes '21 will consult to build out curriculum that one day will accompany the XRP kits.

During an event this week hosted by the British Consulate in Boston, representatives from WPI and DEKA will thank regional educators and politicians for being early adopters of the XRP. Potential new partners will also be introduced to the device in an effort to galvanize additional interest in this groundbreaking technology.

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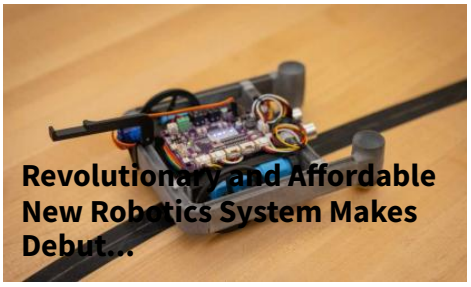

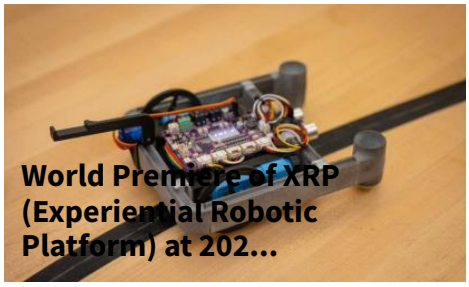

New $2.5 Million NSF Grant Will Fund Scholarship Program for Computer Science Students From Low-Income Backgrounds

Plans Include Summer Program for First-Year Students, Mentoring, Research Opportunities

November 30, 2023

WPI has been awarded a $2.5 million grant from the National Science Foundation (NSF) to boost the enrollment, retention, and graduation of computer science students from low-income backgrounds by providing scholarships, mentoring, and programs that will empower the students to complete their degrees in four years.

The Path to Achieving Success and Sense of Belonging in Computer Science (PASS-CS) project will create a program for academically talented incoming first-year students who are eligible for federal Pell Grants, a form of financial aid for students from low-income backgrounds.

"WPI has a very good four-year graduation rate, as does the computer science department, but Pell recipients in computer science are less likely to complete their degrees in four years," says Rodica Neamtu, professor of teaching in the Department of Computer Science and principal investigator (PI) on the grant. "In keeping with WPI's mission to transform lives through degrees that can drive social mobility, our goal is to develop options and a supportive environment so that students can excel academically and go on to careers in computer science."

Rodica Neamtu

The PASS-CS program will launch in 2024 with eight to 10 first-year undergraduates selected from Pell-eligible students who have been admitted to WPI and plan to major in computer science. Students in the program will be awarded scholarships of up to $15,000 a year for up to four years.

A second group of students will be selected for scholarships and programs in 2025, followed by a third group in 2026. In total, researchers expect to award scholarships and offer supporting programs to about 28 students.

Before the start of the academic year, new students also will be invited to participate in a summer "mini bridge" session on campus that will include math, physics, and computer programming bootcamps. The session will include workshops to help students navigate college life and take advantage of existing campus resources. Students will have access to faculty mentors and options to form small cohorts that will study and take courses together to build community, support structures, and a sense of belonging.

> **"I think we are going to learn a number of important lessons about creating an even better community for WPI students."**
>
> **Rodica Neamtu**
>
> Professor of Teaching, Department of Computer Science

The six-year project is funded by a grant from the NSF's S-STEM program, which aims to build America's workforce by supporting academically talented, low-income students who are pursuing degrees in science, technology, engineering, and mathematics (STEM). PASS-CS is designed around evidence-based strategies for student success and knowledge gained from the Black Student Experience study at WPI, as well as the Great

Minds/CoMPASS scholarship program, an S-STEM program that WPI launched in 2019 to support graduates of the Worcester Public Schools. The university also operates a third S-STEM program for transfer students who plan to pursue careers in clean energy technology.

Neamtu says it's not entirely clear why retention rates lag for computer science students at WPI who have received Pell grants. Between 2015 and 2021, about 76 percent of Pell recipients in computer science remained enrolled at the start of their fourth year. In comparison, 86 percent of their classmates who had not received Pell awards remained enrolled.

"Some students may switch majors or need a fifth year to complete their courses, while others could be working jobs that leave them with less time for studying," Neamtu says. "It's possible that some students do not feel connected to other students in their department and the broader WPI community. We are not sure which factors impact these students, and that is why we are putting together a range of solutions and will investigate how financial assistance, mentorship, and community can make a difference."

Co-PIs on the project are Debra Boucher, assistant dean of undergraduate studies, and Crystal H. Brown, assistant professor in the Department of Social Science and Policy Studies (SSPS). The leadership team also includes Kathy Chen, executive director of the WPI STEM Education Center, and Hermine Vedogbeton, visiting assistant professor at College of the Holy Cross and assistant research professor at WPI, who spearheaded the work on the grant proposal and was originally the PI.

Neamtu says that the research portion of the project will provide insights about student retention that may be useful to the computer science department and other departments in the future.

"If this is successful at supporting students to boost retention and timely graduation, we will want to continue these efforts," Neamtu says. "I think we are going to learn a number of important lessons about creating an even better community for WPI students."

Learn more about WPI faculty

Rodica Neamtu

Professor of Teaching, Computer Science

I am a data mining researcher who investigates how to develop and leverage ground-bı explore time series datasets at the confluence of theoretical computer science and app medicine, neuroscience, economics, transportation, and complex decision making.

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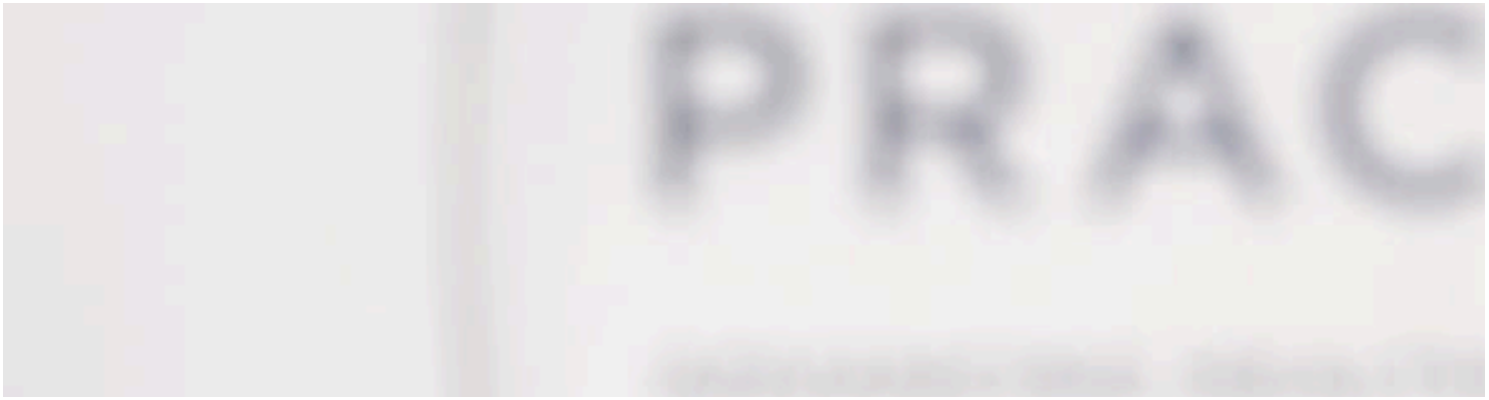

AUTHOR

Kristen O'Reilly

POSTED

November 14th 2023

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Night Mode

As WPI researchers—and alumni—introduce innovative robotic solutions into entirely new workplace environments, understanding how humans interact, appreciate, and

accept these high-tech coworkers takes on greater significance in the quest to harness the strengths of both.

Thanks to a National Science Foundation-funded training grant, a community of researchers within the Department of Robotics Engineering is focusing on this human element, overlaying WPI's distinctive holistic approach to putting theory into practice.

In the stories that follow, read how robots are working alongside humans to reinforce the skills of physical therapists, explore inaccessible areas, complete tedious and physically demanding work, and shoulder dangerous tasks—real-life examples of how robots are essential tools in a high-tech, hybrid workplace of the future.

A Community Built on the Intersection of Humans and Robots

A National Science Foundation-funded training program has helped graduate student researchers think holistically about how humans interact with robots in the workplace, while also providing them with mentoring and career advice. The Future of Robots in the Workplace-Research and Development (FORW-RD) program also created a much-needed community of like-minded graduate students, a community that faculty hope can continue even after the five-year, $3-million NSF grant ends.

The grant came about after principal investigator **Cagdas Onal**, associate professor in the Department of Robotics Engineering, and **Yunus Telliel,** assistant professor of humanities and arts and co-PI, talked informally about the intersection of their work: How robotic technology can be integrated in the workplace in a socially responsible way, and how humans respond to such technology in the workplace.

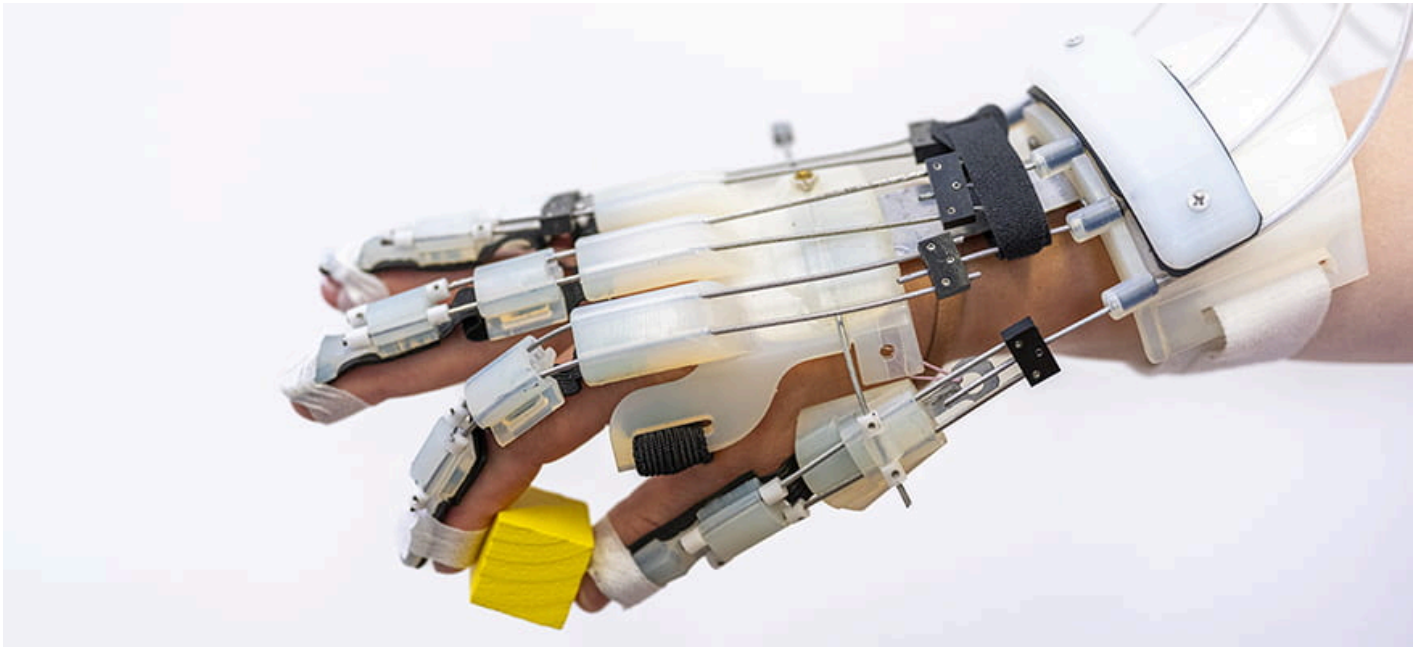
In 2019, they applied for and received a grant from NSF's Research Traineeship (NRT) program, which that year awarded $49 million to 17 institutions across the United States to develop and implement graduate education traineeship models in STEM fields. Since then, 47 trainees—half of whom are international students—have joined the program, with 21 receiving fellowships that include a stipend, tuition, and health insurance. While the grant expires this year, the hope is that the structure can continue using institutional funds or other grants.

In addition to career help and mentoring, FORW-RD trainees participate in specific courses, idea-exchanging seminars, and soft skill development seminars. They also can connect with industry partners, including the five members of the program's advisory board: Heather Cheong of BD AI Institute, Zachary Dydek of Vecna Robotics, Greg Longtine of Amazon Robotics, Nicole Neves of iRobot, and Victor Puksta of

Meta. Each trainee is also expected to complete a thesis/dissertation that includes an aspect of human-robot interfacing in the workplace.

"It started as a funding mechanism, but it's no longer just that," says **Kristen Keane**, NRT program coordinator. Participants continue to be involved in the community even after their funded year, mentoring new trainees and remaining involved in career development and social activities.

Other co-principal investigators include **Jing Xiao**, professor and head of the Department of Robotics Engineering; **Jane Li**, assistant professor of robotic engineering; and **Pratap Rao**, associate professor of mechanical engineering. Other faculty participating include **Soussan Djamasbi,** professor of information systems in The Business School; **Jeanine Skorinko**, professor of psychology and director of the Psychological Science Program; **Berk Calli**, assistant professor of robotics engineering; **Carlo Pinciroli**, associate professor of robotics engineering; **Erin Solovey**, associate professor of computer science; and **Loris Fichera**, assistant professor of robotics engineering.

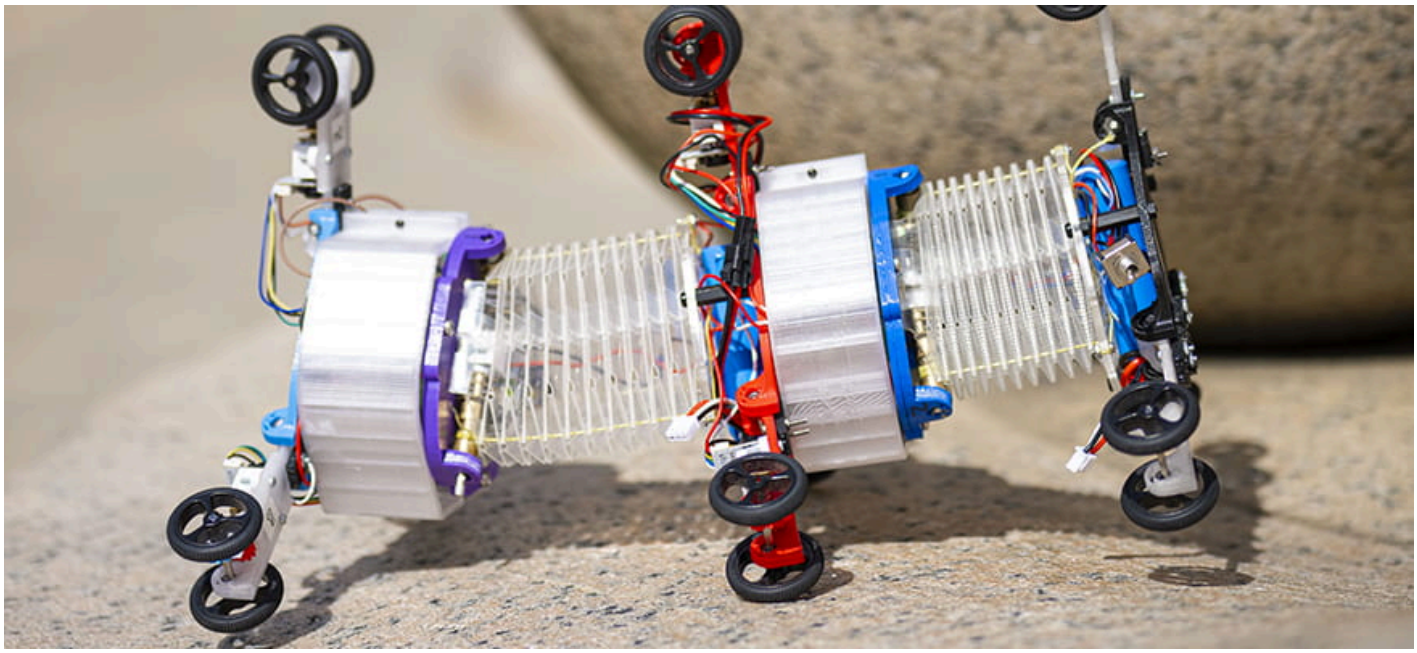


WEARABLE ROBOT OFFERS HOPE

Tess Meier uses an insider's perspective to perfect an exoskeleton hand prototype.

BREAKING UP IS HARD TO DO

Assistant Professor Berk Calli and student researchers work to create a robot to safely break up ships.



A WELCOME INVASION

Associate Professor Cagdas Onal leads research perfecting lizard-like robots that sneak into small spaces for mapping and inspections.

WORKING SMARTER, NOT HARDER

Derrick Morse ’01, MS ’03, cofounded Rugged Robotics to tackle the back-breaking, detailed work of layout transfer.

A RESOURCE FOR SOLVING PROBLEMS

ROSE-HUB bridges the gap between WPI robotics research and the development of commercial technologies.

"In my view, the FORW-RD program is a living testimony to how cross-disciplinary collaboration leads to communal growth," says **James Akl, PhD '23,** a former trainee. "The program's overall structure, the relationships, and the community aspect have been real treasures. Without FORW-RD, my PhD path would have been a much lonelier and isolated path."

"I have learned from FORW-RD that while robotics can be a source of world-changing innovation, we cannot move forward without thinking of the societal, economic, and political impacts of the technology," says **Raagini Rameshwar, PhD '23**. "The FORW-RD program has also provided an invaluable source of community within the WPI graduate program. The cohort is a diverse set of students and together we learn about robotics, social and ethical issues in technology, the world, and ourselves."

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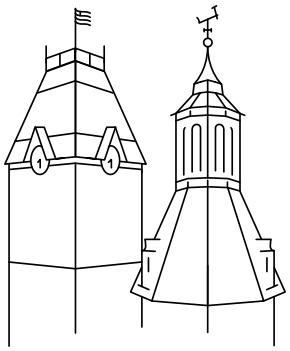

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