



Changing the mind of a robot

Story by KARISHMA ALBAL

Research and big thinking on how AI will impact the future of work in Arizona and beyond

What happens when technology advancements threaten to automate people's jobs?

The question is on the minds of many as research and development in artificial intelligence and machine learning rapidly grows.

A new project led by Siddharth Srivastava, an assistant professor in the School of Computing, Informatics, and Decision Systems Engineering at Arizona State University, aims to help alleviate this concern.

Srivastava and his multidisciplinary team are creating autonomous systems that are not only more adaptable and efficient in manufacturing environments, but also have built-in intelligent tutoring systems that will cooperate with factory workers and retrain them to use AI technology so they are not displaced from their jobs.

Funded by a \$1 million grant from the National Science Foundation as one of its Convergence Accelerator awards, the project is highly focused on using AI to augment the workplace rather than replace workers.

"Suppose you have this new robot, it's very efficient,


but you need to hire five computer science graduates to operate and maintain it instead of five current factory workers,” Srivastava says. “That’s not feasible, first of all because we don’t have that many computer science graduates in society. Our idea is that instead of getting people to enroll in a new college program again, what we can do instead is design our AI systems, our robots, in a way that will help people to come on board.”

Srivastava is collaborating with ASU faculty members in the Ira A. Fulton Schools of Engineering and the School for the Future of Innovation in Society to bring the project to life.

“We have 10 team members, including experts in robot control, tutoring systems and human systems engineering — a field that involves thinking about how the robot and the human would interact and how you would build a situation where the human trusts the robot,” Srivastava says. “We also have experts in law to help solve the sociotechnical aspects of the problem.”

How artificial intelligence can preserve jobs

Traditionally, AI has mostly been developed with a mind to automate human-performed tasks — that is, to perform tasks in place of a human. For example, machines play chess better than humans do and are also faster at distinguishing patterns and performing calculations. One



When Raytheon had a problem with a \$350,000 robotic arm, the industrial corporation joined ASU’s eProjects program, bringing students and industry together to solve real-world problems. The arm was shipped from Tucson to the innovation lab on ASU’s Polytechnic campus in Mesa where ASU students repaired and tested it. Then they returned the robot ready to work.

“Training is where we need to invest more money in order to have a successful integration of workers and autonomous systems so we can minimize safety risks.”

— KATINA MICHAEL,
PROFESSOR, SCHOOL FOR
THE FUTURE OF
INNOVATION IN SOCIETY
AND THE SCHOOL OF
COMPUTING, INFORMATICS,
AND DECISION SYSTEMS
ENGINEERING

example of AI working to augment human-performed tasks rather than replace them can be found in intelligent tutoring systems.

The ASU team is focusing on this interaction, particularly in implementing the intelligent training systems for factory workers. This eliminates the concern about driving up the demand for highly educated workers to unsustainable levels and also empowers human workers to incorporate AI into their work.

“We are now considering scenarios in which the AI system teaches humans on the job,” Subbarao Kambhampati, a professor of computer science, says. “If you are using one machine, and there is a big technological advancement, then the question is what is the



ASU engineering by the numbers

Nation's largest producer of future engineers

—BUSINESS INSIDER AND HIRINGSOLVED SURVEY

Students in engineering and technology

21,206	22,458	23,903
FALL 2017	FALL 2018	FALL 2019

#4 master's degrees awarded by school

— American Society for Engineering Education, Engineering by the numbers, 2018

#8 online graduate engineering programs for veterans

—U.S. News and World Report, 2020



\$63,500

Average salary for first job offer

for a Fulton Schools graduate with a bachelor's degree in engineering

SOURCE: Ira A. Fulton Schools of Engineering

best way to get people to come up to speed in using these new machines?"

This retraining process is essential to helping factory workers in the evolving manufacturing industry keep their jobs. It's a necessary transition into a future when machines can augment human activities without replacing the people who have traditionally performed them.

In that scenario, workers would be able to assign robots a wider variety of tasks while the robots teach workers how to use the robots and why robots are making the decisions they do.

"[Robots] are more adaptable in that their behavior adapts to the changes in their environment, they

adapt to the tasks that you give them and at the same time they can answer your questions," Srivastava says. "A worker who doesn't know the internals of the robot can ask it, 'Why did you go along this path when I think you should have just gone straight?' And the robot can answer, 'If I go this way then my hand might collide with that table.' So, in that process, the worker learns about the robot's constraints and how to operate it."

Moving toward a more robotic future

Could machines ever replace humans? Is it cheaper to have an all-robotic workforce?

The answer is complicated, says Katina Michael, a professor

jointly appointed in the School for the Future of Innovation in Society and the School of Computing, Informatics, and Decision Systems Engineering, one of the six Fulton Schools.

“At face value, initially it seems that robots would do better than the operational expenditure of the human labor force,” she says, “but when you look at this quite clinically,

“Ultimately, it’s getting that multidisciplinary conversation going between people who actually build the machines and people who think very critically about job design and human workers.”

— ERIN CHIOU, PICTURED BELOW, ASSISTANT PROFESSOR OF HUMAN SYSTEMS ENGINEERING, POLYTECHNIC SCHOOL

you’re almost shifting costs from the human labor force to the robotic labor force. It’s quite debatable as to whether costs will be reduced.”

While robots can operate 24/7, people need breaks, time off, insurance coverage and compensation. However, robots must be updated and maintained, and they also need power to operate — human workers are still extremely necessary in the workplace.

Although the research project is focused on AI development, it is ultimately centered around training human workers and ensuring job security. The team wants to enhance communication between both humans and robots to obtain the best of both worlds in the manufacturing industry.

“Many corporations are trying to save money somewhere, but training is where we need to invest more money in order to have a successful integration of workers and autonomous systems so we

can minimize safety risks. If we don’t have adequate training, we don’t have adequate responses to reducing the incidence of on-the-job disasters,” Michael says.

An interdisciplinary interaction

“We’re interested primarily in how humans and robots work together,” Michael says. “With the humans doing their bit and the robots doing their bit, we want to see if there is any incongruousness or congruousness that can be observed.”

Erin Chiou, an assistant professor of human systems engineering at The Polytechnic School, one of the six Fulton Schools, is studying the interactions of humans and machines for data to guide the design of systems that prioritize the collaboration of humans and robots.

“Ultimately, it’s getting that multidisciplinary conversation going between people who actually build the machines and people who think very critically about job design and human workers,” Chiou says.

The ASU team also has experts looking at the legal, social and economic implications of implementing such technology in the workplace, all of which will be considered when designing the new systems.

“It’s not about changing the hardware, it’s about how to change the software,” Srivastava says. “We’re thinking about how it should act and what it should do. We are rethinking how a robot’s ‘mind’ should work in order to make it more amenable to providing on-the-job training and collaborating with humans.” ■

