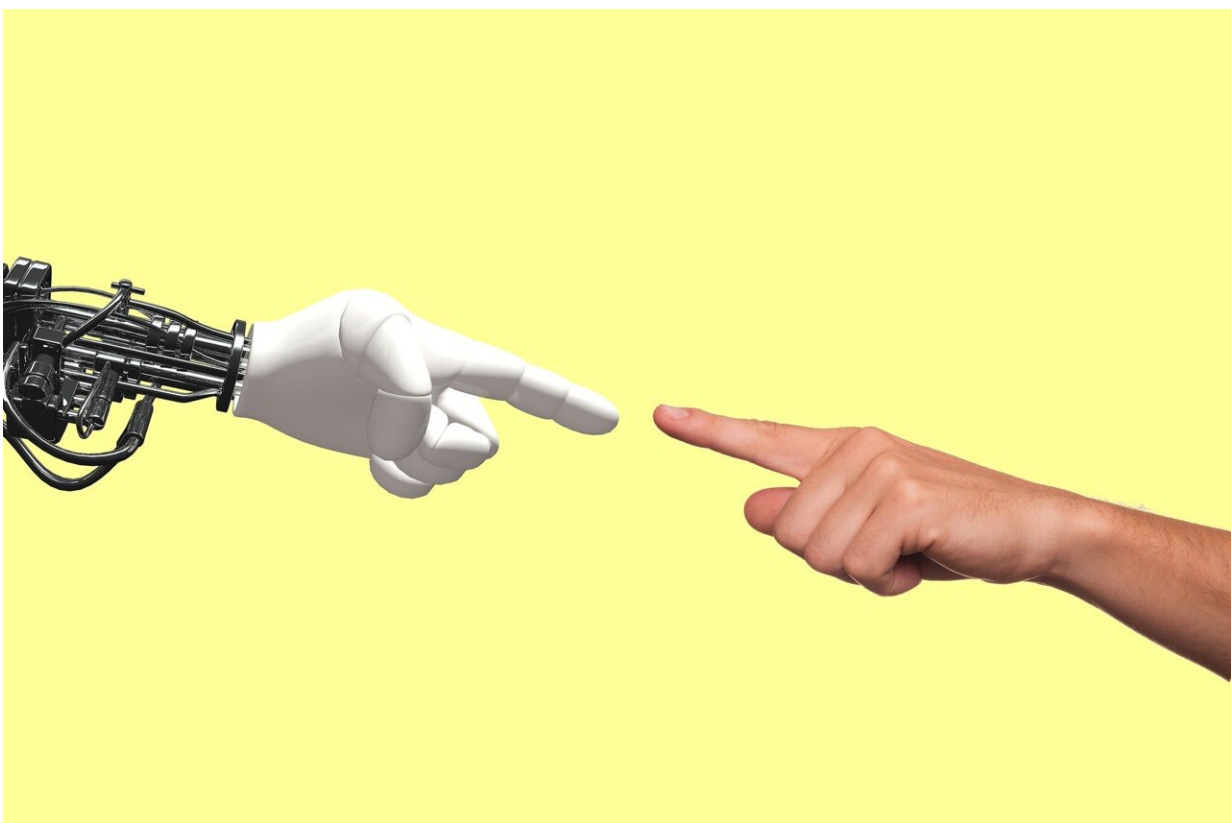


# Robots are everywhere—improving how they communicate with people could advance human-robot collaboration

April 12 2023, by Ramana Vinjamuri

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Credit: Pixabay/CC0 Public Domain

[Robots](#) are machines that can sense the environment and use that information to perform an action. You can find them nearly everywhere

in industrialized societies today. There are household robots that vacuum floors and [warehouse robots](#) that pack and ship goods. [Lab robots](#) test hundreds of clinical samples a day. [Education robots](#) support teachers by acting as one-on-one tutors, assistants and discussion facilitators. And [medical robotics](#) composed of prosthetic limbs can enable someone to grasp and pick up objects with their thoughts.

Figuring out how humans and robots can collaborate to effectively carry out tasks together is a rapidly growing area of interest to the scientists and engineers that design robots as well as the people who will use them. For successful collaboration between humans and robots, communication is key.

## **How people communicate with robots**

Robots were originally designed to [undertake repetitive and mundane tasks](#) and operate exclusively in robot-only zones like factories. Robots have since advanced to work collaboratively with people with new ways to communicate with each other.

[Cooperative control](#) is one way to transmit information and messages between a robot and a person. It involves combining human abilities and decision making with robot speed, accuracy and strength to accomplish a task.

For example, robots in the [agriculture industry](#) can help farmers monitor and harvest crops. A human can control a semi-autonomous vineyard sprayer through a [user interface](#), as opposed to manually spraying their crops or broadly spraying the entire field and risking pesticide overuse.

Robots can also [support patients in physical therapy](#). Patients who had a stroke or spinal cord injury can use robots to practice hand grasping and assisted walking during rehabilitation.

Another form of communication, [emotional intelligence perception](#), involves developing robots that adapt their behaviors based on social interactions with humans. In this approach, the robot detects a person's emotions when collaborating on a task, assesses their satisfaction, then modifies and improves its execution based on this feedback.

For example, if the robot detects that a physical therapy patient is dissatisfied with a specific rehabilitation activity, it could direct the patient to an alternate activity. [Facial expression](#) and body gesture recognition ability are important design considerations for this approach. [Recent advances in machine learning](#) can help robots decipher emotional body language and better interact with and perceive humans.

## Robots in rehab

Questions like how to make robotic limbs feel more natural and capable of more complex functions like typing and playing musical instruments have yet to be answered.

I am an [electrical engineer](#) who studies how the brain controls and communicates with other parts of the body, and [my lab](#) investigates in particular how the [brain](#) and [hand](#) coordinate signals between each other. Our goal is to design technologies like prosthetic and wearable [robotic exoskeleton devices](#) that could help improve function for individuals with stroke, spinal cord and traumatic brain injuries.

One approach is through [brain-computer interfaces](#), which use brain signals to communicate between robots and humans. By accessing an individual's brain signals and providing targeted feedback, this technology can potentially improve recovery time in [stroke rehabilitation](#). Brain-computer interfaces may also help [restore some communication abilities](#) and [physical manipulation of the environment](#) for patients with motor neuron disorders.

## The future of human-robot interaction

Effective integration of robots into human life requires balancing responsibility between people and robots, and designating clear roles for both in different environments.

As robots are increasingly working hand in hand with people, the [ethical questions](#) and challenges they pose cannot be ignored. Concerns surrounding [privacy](#), [bias and discrimination](#), [security risks](#) and [robot morality](#) need to be seriously investigated in order to create a more comfortable, safer and trustworthy world with robots for everyone. Scientists and engineers studying the ["dark side" of human-robot interaction](#) are developing guidelines to identify and prevent negative outcomes.

Human-robot interaction has the potential to affect every aspect of daily life. It is the collective responsibility of both the designers and the users to create a human-robot ecosystem that is safe and satisfactory for all.

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