Misty—A Development Platform for Socially Assistive Robots

By Srivatsan Srinivasan

Socially assistive robots (SARs) serve as assistants that help people through social interactions. To completely understand what that means, we need to look at two distinct areas of robotics that have been around for quite some time. SARs are an amalgam of the capabilities of socially interactive robots and the intentions of assistive robots.

The main purpose of socially interactive robots is to interact with people through speech, gestures, and other modes of communication that humans can understand. These robots have been deployed in hospitality settings, such as hotel lobbies and welcome stations, where they serve as interactive information kiosks and guides.

Assistive robots, on the other hand, help people with physical disabilities through physical interactions. They include rehabilitation robots, robotic mobility assistants and wheelchairs, manipulative arms, and so forth. Although the term *assistive robotics* covers all robots that provide some form of physical assistance, it is not quite an umbrella term because robotics can solve problems that go beyond the need for such aid.

This is exactly where SARs come into play—they provide nonphysical assistance to human users through social interactions. There is plenty of application space for such robots, ranging from aiding children with autism to rudimentary tutoring to help out teachers. For these applications to make an impact, the robots need to be expressive and interactive. Technologies such as speech, gesture recognition, expressiveness, voice recognition, and artificial intelligence are important. In addition to the software that operates them, it is vital that the robots' appearance endears them to us—especially to children and the elderly.

This issue of *IEEE Robotics and Automation Magazine* focuses on the various capabilities and latest technologies in this area. Let's focus here on what students interested in researching and developing an SAR need to know. Among the first things they would need to determine is a development platform—preferably one that provides certain functionality right out of the box. That way, they won't have to get into the complications of prototyping, creating lower-level controls, focusing on making the robot move, and other time- and resource-intensive activities.

A fun little robot called Misty, made by Misty Robotics, Boulder, Colorado, checks all those boxes so that software developers can get up and running with this sort of research and development quickly and easily. I could tell you a lot of things about this robot, but I think learning from my close friend, CP Sridhar, a developer at Misty Robotics, would be even better.

Srivatsan Srinivasan: Hi, CP! Thanks to you and Misty Robotics for agreeing to share your thoughts. Could you please tell me a little bit about your robotics background, and what drew you toward Misty Robotics?

CP Sridhar: First, thank you for thinking of Misty for this article. I completed my master's in mechatronics and robotics at New York University. My specialization was in controls of decentralized swarming. I began work as a robotics controls intern at Mitsubishi Electric Research Laboratories in Cambridge, Massachusetts. I have always been very hands-on with robotics and enjoy building systems that interact with humans. This element of human interaction and the company vision of robots working alongside us in our homes and businesses attracted me to Misty.

Srinivasan: What makes Misty unique, and why is she ideal for developers?

Sridhar: Today, the out-of-box experience you get with most robots is that they are either too simple because designed for novices or too complicated for a nonrobotics engineer to use right away. In addition to this disparity in capability and sophistication, there are often big differences in the appearances of these robots. They range from what are essentially rolling boxes to extremely advanced, bipedal, humanoid-looking robots. I believe Misty meshes a powerful robotics platform with an appealing industrial design that will be crucial to children, the elderly, and others accepting her and interacting with her socially (Figure 1).

Something that's kept software engineers from getting into writing

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Figure 1. Undergraduates work to attach a gripper arm to Misty. (Source: Misty Robotics.)

Figure 2. A group of students explores Misty's hardware-expandability packs. (Source: Misty Robotics.)

code for robots is the hurdles robot hardware often throws at them. Most of these developers don't have the knowledge or desire to get down into the firmware and write low-level driver code just to make the robot do basic things. Misty definitely breaks down this barrier by providing a fully capable hardware stack that's programmable in JavaScript, C Sharp, or Python, along with well-documented application programming interfaces (APIs) and architectures that are familiar to software developers. Complicated features, like simultaneous localization and mapping (SLAM), audio localization, face recognition, and more, are built right into the robot's software. For those who are more hardware-curious, Misty can wear a backpack that supports universal asynchronous receiver/transmitter communication (Figure 2). This allows developers to extend Misty's native capabilities by incorporating external hardware, like an Arduino or Raspberry Pi, into their work. This combination of advanced capabilities, open software, and extensible hardware makes Misty an ideal robot for software developers who want to innovate outside of mobile and web applications.

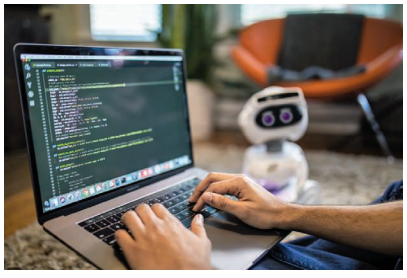

Figure 3. A developer programs Misty. (Source: Misty Robotics.)

Figure 4. Misty poses for photos at San Francisco DeveloperWeek. (Source: Misty Robotics.)

Srinivasan: Could you please elaborate on some of the things developers can look forward to in Misty straight out of the box?

Sridhar: Having worked with many robots, my personal favorite feature is Misty's programmable personality. Developers can choose how they want their Misty to look, sound, and behave, and they have the freedom to alter how she responds to humans in a variety of ways. This includes simple things, like having Misty make an angry face and say "ah" when someone grips her handle or having her make a happy face and a corresponding sound when someone touches her cheek.

These types of seemingly basic social interactions have never failed to draw people toward Misty when she is out and about in public. Other amazing features include mapping and navigation, audio recording (and the ability to know where those sounds come from), video recording, face detection and recognition, capacitive-touch sensors, wireless charging, and the ability to talk to any number of cloud services that might be running on Microsoft, Google, Amazon, IBM, and so on. Additionally, developers can hack Misty's physicality by creating new arms, headpieces, backpacks, and other attachments for her. But above everything else is the Misty skill system that makes her extremely easy to code. We've seen early developers build cool skills for Misty in just 30 min (Figure 3).

Srinivasan: What are the features of Misty that make her a good platform for SAR development?

Sridhar: Given a specific focus on SAR development, I would say audio input to the robot is most valuable. Developers can choose to pipe the audio through a recurrent neural networks model, or they can use a service to extract intent and act on this information later to have Misty behave accordingly. This could be used for actions like toggling the state of a connected device or making a phone call.

These scenarios can be enhanced with SLAM, face recognition, and audio localization—Misty can actually look at you, know your name, and even follow

Figure 5. Misty responds to a kiss from Nibble, the Misty Robotics office puppy. (Source: Misty Robotics.)

Figure 6. Misty picks up a delivery. (Source: Misty Robotics.)

you as you speak. We have also been seeing traction around the idea of Misty as a concierge. She can help people at events by responding to simple questions like "Hey Misty, where is the bathroom?" as well as complicated requests like "Hey Misty, please take me to conference room 24."

Srinivasan: What are some of the fun projects you have worked on at Misty Robotics, and could you provide details about them?

Sridhar: The most fun I've had, so far, was making Misty follow a ball. It was just a proportional-derivative controller in action, but the beauty of Misty—with three degrees of freedom in her head movements, her facial expressions, and her audio capabilities—made this project so much fun. We had the skill running at an event in San Francisco, and people loved playing with her (Figure 4). Even Nibble, the Misty office puppy, loves this skill (Figure 5).

Some other, more practical, skills (Figure 6) include Misty guarding my workstation and alerting me if someone she doesn't recognize starts hanging around it. In that skill, Misty alerts the unknown person with a scary voice, flashes some connected Philips Hue lights, and sends me a text message via Twilio. The cherry on top? Misty takes a photo of the intruder and sends it to a Polaroid printer for immediate identification.

In another skill, I attach a temperature sensor to Misty's backpack, and she activates a fire alarm when she senses too much heat. In yet another skill, we connected Misty to Microsoft's cognitive services APIs so that she can understand human emotion by looking at a person's face and offer words of encouragement when she recognizes that someone is sad. There are so many possibilities for building with Misty.

Figure 7. Misty Robotics launched Misty II in 2018. (Source: Misty Robotics.)

Srinivasan: Is it possible to draw parallels between some of the features you helped develop with Misty and some of the features that an SAR would require?

Sridhar: I would say all the features our team has been working on at Misty could be used in any number of SAR use cases. As the robotics and prototype engineer at Misty, I get to experiment with applications and use cases and then follow up with engineering to determine if integrating the capabilities I am exploring makes sense and, if so, at what level. Often, this results in building new features (or improving existing ones), in addition to improving the experience of working with the platform for developers (Figure 7).

Srinivasan: Are there some user stories you could provide of developers, researchers, and/or companies that use Misty in an educational and/or healthcare setting?

Sridhar: A team at the University at Albany, New York, is working on robotic skills to aid disabled people in their vocations. We've been in early discussions regarding using Misty as a tool to teach autistic kids emotions and coding. We're seeing interest in human–robot interaction research to discover how much humans trust technology and, especially, a robot with personality. We recently received lots of interest from libraries and makerspaces where students can work with tech that's otherwise financially out of their reach. We've even written a blog post about why a robot like Misty is perfect for education.

My thanks to CP and Misty Robotics for this interview. I'm sure a lot of readers will find this information about SAR and Misty exciting and helpful. I sure did! Please follow Misty Robotics on Twitter, @MistyRobotics, and Instagram, @mistyrobotics.