DIMENSIONS 7.5" (L) × 7.5" (W) × 13.6" (H)

WEIGHT 10.1 pounds

FUR

Tega's furry coat is easily removable, and designed to withstand repeated hugs, tickles, and exploratory pats. In fact, thanks to capacitive touch sensors on the head and the belly of the coat, Tega can recognize physical interactions and react accordingly.

SPEECH

Kids respond to expressive speech, especially during storytelling, and it can help them learn and retain more words and information. Computer-generated speech is often too monotonous, so PRG tapped a youthful-sounding teammate to record a library of scripted dialogue. Tega's animated mouth is virtually articulated and can produce lip-sync that corresponds with its speech.

FACE

As Tega listens to a child speak, it exhibits backchanneling, aka active listening, with utterances or by gazing, smiling, nodding, or leaning forward.

The New Robot in School

Meet Tega—one of the newest creations from the Personal Robots Group (PRG), led at the MIT Media Lab by associate professor of media arts and sciences Cynthia Breazeal SM '93, ScD '00.

PRG is working toward a future in which, simply put, we "live better with robots." Its award-winning creations Nexi and Leonardo, for example, are designed to fit engagingly into peer-to-peer teamwork and family life. "Over the past few years," Breazeal says, "our research has focused on advancing the artificial intelligence, user experience design, and application of social robots in the real world where they help people achieve long-term goals and can build personalized and positive relationships." Educational goals are of particular interest: "There is huge need to help children enter school ready to learn, and social robots can offer something truly unique as an intervention both in schools and homes."

WATCH TEGA IN ACTION
spectrum.mit.edu/tega

Enter Tega, the product of extensive research on child-robot interaction and educational best practices. The development of Tega was led by former graduate student Jin Joo Lee SM '11, PhD '17, along with numerous contributors who designed and assembled early prototypes. Research scientist Hae Won Park has spearheaded the interaction intelligence and deployment of Tega out in the field—most recently on a three-month literacy study in Massachusetts kindergartens, meeting weekly with children from 12 different classrooms. Tega is equipped to tell stories to kids, then to conduct autonomous conversations about those stories, testing comprehension and vocabulary and making emotional or inferential prompts ("how did the frog feel?" or "what will happen next?")—all while tailoring its hints and reactions to the child's verbal and physical responses. Eventually, Tega invites the child to retell the story. "By analyzing the story and speech sample, Tega can gauge that child's language ability and which parts of a

MECHANICAL CHASSIS

When kids first meet Tega, Park says most are excited, while some are nervous: "It's as if they're seeing a puppy for the first time. Some kids actually ask if it's going to bite!" The scientists remove Tega's fur and show students the machinery underneath. "Regardless, they treat Tega as something alive—as their friend."

CAMERA

Tega's ability to collect visual data is extended with an external high-resolution, wide field-of-view camera.

SMARTPHONE

Tega utilizes an Android smartphone as an embedded device for displaying graphics, playing speech and sounds, networking, collecting and sending sensor data (microphone, camera, and accelerometer), as well as computation for behavior and motor control. Heavier computations for making interaction decisions are conducted in the cloud.

BATTERY

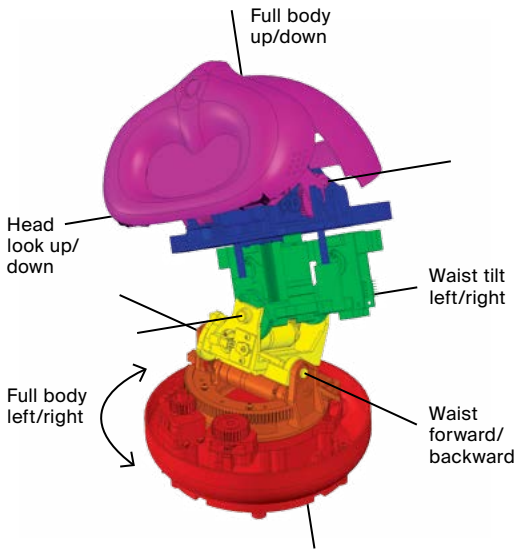
Tega's efficient battery-powered system can run for up to six hours without being recharged.

MOTOR CONTROLLER STACK

The motor controllers on Tega know the current position of each joint by reading encoder values. They communicate with the smartphone to receive next-position commands and send signals to the motors to reach the goal positions using feedback control.

DEGREES OF FREEDOM

Guided by conceptual character animations, the team gave Tega five basic degrees of freedom, with "squash-and-stretch" capability. Tega combines these movements to express a range of emotions on a matrix of valence (positivity/negativity) and arousal (level/intensity)—such as nodding to agree, leaning in to show engagement, tilting its head in thought, or straightening up in excitement.



story the child is particularly interested in," says Park. Relationship-building moments—such as conversations in which both child and robot share what they like about school—are key to nurturing richer, more personalized repeat interactions.

Tega's bubbly, childlike demeanor makes it a unique research tool as well as educational platform. "As human beings, we are wired to learn from others," Breazeal observes. And because it is designed to interact with kids as a peer rather than a tutor and to model productive mindsets, Tega offers a powerful, flexible social learning dynamic that PRG is doing rigorous experiments to better understand. Findings so far have reinforced the idea that "we learn not just knowledge and skills from others, but also important attitudes about learning—such as to be open and curious, to persevere through challenge, and to see mistakes as an opportunity to learn and grow."

Robot Design, Assembly, and Development
Version 1: Jin Joo Lee SM '11, PhD '17, Luke Plummer '14, Kristopher dos Santos '10, SM '12, Sigurður örn Aðalgeirsson, Cooper Perkins Inc., IFRobots Inc., Stacey Dyer, Fardad Faridi. Version 2: Hae Won Park, Meng Xi, Randi Williams, Cooper Perkins Inc.

Advisors on Classroom Interactions and Data Analysis
David DeSteno, Northeastern University; Paul Harris, Harvard University; Stephanie Gottwald, Curious Learning; Maryanne Wolf, Stanford University

PHOTOS: BRUCE PETERSON