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GET TO KNOW THE ROBOTS FEATURED IN *ROBOT REVOLUTION!*

The Museum of Science and Industry, Chicago (MSI)'s national touring exhibit, *Robot Revolution*, supported by Google.org with additional major support from The Boeing Company, boasts an unprecedented selection of robots that have been secured from all over the world. Guests will have extraordinary opportunities to meet and interact with these remarkable machines.

The exhibit is divided into four main areas—Cooperation, Skills, Smarts and Locomotion—to familiarize guests with the various aspects of robotics.

COOPERATION

Discover how engineering breakthroughs are helping create robots that can work with humans to enhance our lives, including:

- **Omron LD Mobile robot** from Omron Adept Technologies, Inc. in San Ramon, Calif.: This self-navigating autonomous indoor vehicle (AIV) is designed to move material in challenging environments, including confined passageways. In our exhibit, it helps the Robot Specialist with their duties.
- **EMYS** from Wroclaw University of Technology in Poland: This social machine uses a Facial Action Coding System to mimic guests' faces and express basic human emotions with its head and eyes. Guests can also interact with EMYS to trigger facial emotions like happiness, fear and surprise.
- **Ekso GT Robotic Skeleton** from Ekso Bionics in Richmond, Calif.: EKSO is a wearable robot, which provides extra strength and endurance. It can be used to help those who have problems walking or who are paralyzed.
- **PARO®** from Dr. Takanori Shibata of Japan's National Institute of Advanced Industrial Science and Technology: Guests experience how PARO, a therapeutic baby harp seal robot, is used to help the physical and emotional health of medical patients.
- **Soccer Robots** from the ZJUNlict Team of Zhejiang University in China: The soccer 'bots go head to head in a competition, using the same rules as human players. See which team of robots wins in the ultimate game of autonomy, as they play without any human input!

SMARTS

See how these machines are able to sense, plan and then act, while comparing and contrasting the ways in which humans and robots learn. Robots featured are:

- **Baxter** from Rethink Robotics, Inc in Boston: Guests play tic-tac-toe with this smart, collaborative robot, easily trained for a wide range of simple, repetitive tasks. Because this robot can be programmed remotely, smaller companies with fewer resources can use Baxter.
- **Cube Solver** from Rixan Associates and DENSO in Dayton, Ohio: This robot is able to solve a Rubik's Cube by using a standard gripper to hold the cube up to a color camera, containing a vision system run on a Windows PC. This vision system sees the colors, and smart image-processing software figures out how to solve the puzzle almost as fast as the gripper can turn the cube.

- **LiDAR** sensors from Velodyne in Morgan Hill, Calif.: While sitting in a mock-up of a **self-driving car**, guests experience a simulated drive down a city street, learning how the car operates using LiDAR (“light” and “radar”) sensors that assess road conditions and can “see” obstacles, including other cars.
- **ROBOTIS-OP** from ROBOTIS in South Korea: This humanoid robot uses face-tracking software to sense when a human is looking at it, and can align its gaze with that of a guest’s.
- **UR5 Robot Arm** from Universal Robots in Denmark: Guests can teach this robotic arm basic motions, as it learns to repeat movements demonstrated by its user. Guests can manipulate it to their liking, then watch it play back the same motion!

SKILLS

Learn about the skills robots possess that mimic—and often surpass—human capabilities. This area features robots like:

- A wide variety of **gripping robots**. Guests place objects for the grippers to pick up and observe their varied and specific traits, developed for their work environment. These robot-gripping interactive stations demonstrate how challenging it is to replicate the gripping ability of a human and include:
 - **Bellows Gripper** from FESTO of Germany: A soft gripper with a gentle touch that inflates a rubber or silicone ball so that it can safely pick up a delicate glass and place it next to other glasses in a carton.
 - **Bionic Handling Assistant** from FESTO: Inspired by an elephant’s flexible and powerful trunk and made of rings of flexible plastic, so there are no rigid joints. It has 11 degrees of freedom and can move through space as no other robot arm can.
 - **Fin Gripper** from FESTO, which functions like the muscles in a fish’s tail, with struts connecting to flexible bands that allow it to adjust its shape without putting much pressure on the object it grasps.
 - **Learning Gripper** from FESTO, which learns by using sensors in its fingertips. If robots can learn on their own, they won’t need to be reprogrammed for each new task.
 - **Adaptive Gripper** from Robotiq of Canada is used in factories, where it handles tough and punishing jobs. It has three fingers, 10 degrees of freedom and, like humans, it can grasp, pinch and enclose very tiny objects.
 - **Industrial Grippers** from SCHUNK in Germany: Its sturdy and simple grippers can be used to grasp a variety of small objects. They can be easily modified with pads, sleeves and sensors, making them useful in many kinds of industrial environments.
 - **VERSABALL®** of Empire Robotics in Boston, a highly adaptable squishy gripper. When the inflated ball is lowered, the particles inside the gripper surround the object. VERSABALL® uses very little force when grasping objects and can handle fragile items, such as light bulbs.
- **Robotic21 System** from Yaskawa Motoman Robotics of Japan: Guests play a game of 21 with this revolutionary robot, which uses two suction cups circling its grippers to pick up playing cards.
- **Fanuc delta robot** of FANUC of Japan: This robot is highly skilled at factory assembly line tasks because of its ability to select and sort items with precision and speed. In the exhibit, the robot quickly sorts different colored items into separate bottles.

LOCOMOTION

Explore the variety of ways that robots can move and how they can offer humans access to places we can't venture ourselves. Robots include:

- **CHARLI** of Terrestrial Robotics Engineering & Controls, Virginia Tech and RoMeLa in Blacksburg, Va.: CHARLI is a humanoid robot that can walk in all directions, turn, kick and other simple upper-body tasks.
- Three different **drones** on display:
 - The **Phantom drone** from DJI of China, a flying camera drone, which provides an unprecedented photographic experience as anyone can learn to fly this commercially available drone. This particular kind was made famous for crashing on the White House lawn.
 - The **Walkera TALI H50 Carbon Edition** drone is a GPS hexacopter drone that can be equipped with a GoPro camera.
 - The **HyTAQ Quadcopter** of the Illinois Institute of Technology in Chicago, Ill., operates both on the ground and in the air, making it useful in many situations.
- **DROP** of the NASA Jet Propulsion Lab in Pasadena, Calif.: This climbing robot has tiny hooks that fan out from its wheels on flexible treads to grip wood, concrete and stucco. Each microspine is very small, but together they hold the robot's weight with ease.
- **Daisy** from HEBI Robotics in Pittsburgh, Penn.: This six-legged hexapod, which moves in ways that are similar to a spider, is being used in urban search and rescue, archaeological exploration and more.
- **MURATA BOY and MURATA GIRL** from Murata of Japan: MURATA BOY can ride a bike very slowly and even balance while still, which humans can't do. MURATA GIRL rides forward and backward and also balances while still.
- **Recon Scout® Throwbot® XT** of Recon Robotics in Edina, Minn.: Used by the police and military to explore dangerous environments before sending in people, this rugged, remotely operated micro-robot can maneuver through cluttered indoor environments and over landscapes of dirt, sand and rocks. Guests can issue commands to this robot to navigate ramps and other terrain.
- **RHex** from the University of Pennsylvania in Philadelphia: Guests can control this robot around rough and rugged terrain in a small arena. With springy legs, RHex is able to sprint across flat ground, fling itself up curbs and leap over gaps, especially in hard-to-traverse rocks and sand.
- **RiSE** from the University of Pennsylvania: RiSE is able to shimmy and crawl up brick and stucco walls, moving one of its six legs at a time.
- **ROBOTIS-MINI** from ROBOTIS: By controlling these miniature versions of ROBOTIS-OP, guests can make ROBOTIS-MINI put one foot in front of the other, perform dance routines and more.
- **OSCAR** from TOPY of Japan: Built like a miniature tractor, this robot climbs up or down steps as steep as 45 degrees and can investigate unstable buildings to send information to humans, keeping people out of dangerous situations.

Other robots on display and at work throughout the exhibit include:

- **Cubelets** from Modular Robotics in Boulder, Colo.: Guests can snap these together to create a robot, teaching them about basic robotic components.
- **RoboThespian** from Engineered Arts Ltd of England: When guests enter the exhibit, they will be greeted by a life-sized humanoid robot, specifically designed for human interaction in a public environment. It can be programmed with multiple commands.

- **Yume Robo** from Muscle Corporation of Japan: In the Museum's Entry Hall, guests can watch as a 60-pound robot with arms and legs, coordinated by smart motors, climbs a ladder.

An exciting, 10-minute **Drone Show** will take place several times an hour, offering a fascinating glimpse into what these popular devices can do. Featured in this live demonstration is the **Parrot MiniDrone**, an ultra-compact drone controlled by smartphone and tablets.

Guests will also get an inside look at the regular maintenance of the robots in the **RoboGarage**. Inside this dynamic space, robots get checked and repaired to keep them operating smoothly. Watch as our highly trained robot specialists check sensors, troubleshoot programming and keep the exhibit full of functioning robots!

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