



Manufacturing

Robonaut 2: Industrial Opportunities

Handles factory tasks that are ergonomically difficult, fatiguing, or even unsafe for humans

Researchers at the NASA Johnson Space Center (JSC) in collaboration with General Motors (GM) and Oceaneering, have designed a state-of-the-art, highly dexterous, humanoid robot: Robonaut 2 (R2). R2's nearly 50 patented and patent-pending technologies have the potential to be game-changers in many applications such as the industrial environments. For example, in a traditional robotic assembly line there are multiple specialized robots that are tooled for a small set of unique tasks. R2 provides an alternative way to implement automated assembly using extraordinary task flexibility, dexterity and rapid interchangeability with human processes and tools. This can lower automation infrastructure costs and increase manufacturing flexibility. R2 can serve as an assistant or work independently. R2's dexterity is a key feature in industrial environments as the robot can handle factory work that is ergonomically difficult, fatiguing, or even unsafe.

BENEFITS

- ➔ Touch Sensitive: Uses its vision, force and tactile sensing to carry out tasks in real time
- ➔ Upper Body: Capable of being stationary or integrated onto a two/four-wheeled base
- ➔ Environmental Awareness: Designed to handle unexpected objects coming onto its path
- ➔ Dexterous: Capable of handling many of the same tools used by humans
- ➔ Task Flexibility: Performs multiple tasks as an assistant worker or independently
- ➔ Safe: Works side-by-side with people

APPLICATIONS

- ➔ Manufacturing
- ➔ Automotive
- ➔ Industrial Applications
- ➔ Hazardous Chemicals and Products Manufacturing
- ➔ Chemical and Petroleum Plants

technology solution



THE TECHNOLOGY

NASA, GM, and Oceaneering approached the development of R2 from a dual use environment for both space and terrestrial application. NASA needed an astronaut assistant able to function in space and GM was looking for a robot that could function in an industrial setting. With this in mind, R2 was made with many capabilities that offer an enormous advantage in industrial environments. For example, the robot has the ability to retool and vary its tasks. Rather than a product moving from station to station on a conveyor with dozens of specialized robots performing unique tasks, R2 can handle several assembly steps at a single station, thereby reducing manufacturing floor space requirements and the need for multiple robots for the same activities. The robot can also be used in scenarios where dangerous chemicals, biological, or even nuclear materials are part of the manufacturing process.

R2 uses stereovision to locate human teammates or tools and a navigation system. The robot was also designed with special torsional springs and position feedback to control fine motor movements in the hands and arms. R2's hands and arms sense weight and pressure and stop when they come in contact with someone or something. These force sensing capabilities make R2 safe to work side-by-side with people on an assembly line, assisting them in ergonomically challenging tasks or working independently.

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VISION: Infrared cameras for depth perception and 4 visible light cameras to provide stereo vision as auxiliary cameras

NECK: 3 degrees of freedom

HANDS: 12 degrees of freedom
4 in the thumb and 3 each in the index and middle fingers

ARMS: 7 degrees of freedom and approximately 2'8" long

FINGERS: 5 pounds grasping force/finger. A minimum of 20 lbs. across the hand.

TORSO: R2's brain

R2 SYSTEM: 50 actuators, 350 sensors, and 42 independent degrees-of-freedom

R2 is a humanoid robot with many capabilities that allow it to perform tasks normally not done by robots.



Robonaut 2 lifting a 20 lbs weight with one hand, showing the robot's strength and endurance.

PUBLICATIONS

Patent No: 8371177; 8056423; 8280837; 7784363; 8250901; 8244402; 8265792

Patent Pending

Included is a sample list of the R2 sensor technology patents. For patent information on the complete R2 system, please visit <http://go.nasa.gov/1xWCiU5>.

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