



Environment

Robonaut 2: Hazardous Environments

Advanced robotics with teleoperations capabilities

Researchers at the NASA Johnson Space Center (JSC) in collaboration with General Motors and Oceanearing, have designed a state-of-the-art, highly dexterous, humanoid robot: Robonaut 2 (R2). R2 is made up of multiple systems and sub-components: vision systems, image recognition systems, sensors, control algorithms, and much more. R2's nearly 50 patented and patent-pending technologies have the potential to be game-changers in multiple industries. One of the most promising application for the R2 technologies is in the area of hazardous environments. R2 has the capability to work in remote locations separate from the human controller. R2 can function autonomously or it can be controlled by direct teleoperations.

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BENEFITS

- ➔ Teleoperations: R2 can be controlled by direct teleoperations
- ➔ Sensing: Uses its vision, force and tactile sensing to carry out tasks in real time
- ➔ Dexterous: Capable of using many of the same tools created for human use
- ➔ Environmental Awareness: Able to clear objects from its path
- ➔ Visual system: Multiple cameras provide stereo vision and depth perception

APPLICATIONS

- ➔ Nuclear
- ➔ Toxic Waste Disposal
- ➔ Difficult Terrain
- ➔ Sorting Hazardous Items
- ➔ Bomb Disposal
- ➔ Disaster Relief Areas
- ➔ Chemical Plant Operations

technology solution



THE TECHNOLOGY

Robonaut 2 (R2) has the capability of functioning autonomously or it can be controlled by direct teleoperations, which is advantageous for hazardous environments. When functioning autonomously, R2 understands what to do and how to do it based on sensory input. R2's torso holds the control system while the visor holds several cameras that are incorporated into the visual perception system. With these capabilities, R2 can reduce or eliminate the need for humans to be exposed to dangerous environments. R2 also has a very rugged four-wheel base called the Centaur 2. The Centaur 2 base can lower or raise itself to and from the ground and turn its wheels in any direction, allowing it to turn in place and drive forward or sideways. This enables the R2 to enter hazardous areas or tackle difficult terrain without endangering its human operator.

Robonaut 2 as a whole, or some of its components, can be an invaluable tool for land mine detection, bomb disposal, search and rescue, waste recycling, medical quarantined area, and so much more. The suite of technologies provides an ability to manipulate tools to help with a task, or it can tackle many tasks in a row, where a standard robot may not have the dexterity or sensing capability to get the job done. R2 could pick through nuclear waste, measure toxicity levels, and survey areas too remote or dangerous for human inspection. R2 could deal with improvised explosive devices, detect and dispose of bombs or landmines, and operate equipment that can break through walls or doors.



Robonaut 2 with the Centaur 2 demonstrating the technology capabilities.

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



TORSO: R2's brain

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

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

Robonaut 2 is a humanoid robot with many capabilities that allow it to perform tasks normally not done by robots.

PUBLICATIONS

Patent No: 8170718; 8364314; 9,120,224; 8260460; 8483882; 8676382; 8483877; 8,706,299; ; 8,868,234; 8,868,241; 8,868,234

Patent Pending

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

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