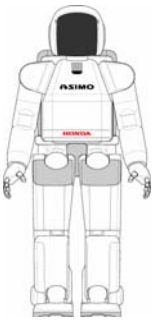
ASIMO



Frequently Asked Questions

Basic Facts	
What does the name *ASIMO* stand for?	• *ASIMO* stands for "Advanced Step in Innovative Mobility."
Who created ASIMO?	• ASIMO was developed by Honda Motor Co., Ltd., a world leader in advanced robotics.
Why was ASIMO developed?	• ASIMO was created to be a helper to people. ASIMO's height of four feet, three inches (130 centimeters) makes it the perfect size for helping around the house, or assisting a person confined to a bed or a wheelchair. ASIMO's size also allows it to look directly at an adult sitting in a chair or sitting up in bed for easy and natural communication.
How long did it take to develop ASIMO?	• Honda's development of a humanoid robot began in 1986. • The world's first self-regulating, bipedal (two-legged) humanoid robot, named P2, was completed by Honda in December 1996. • P3, the first completely independent, bipedal humanoid walking robot, arrived in September 1997. P3 stood 5'2" tall and weighed 286 pounds (130 kilograms). • ASIMO was completed October 31, 2000 and remains the most advanced humanoid robot ever created. • New ASIMO was first demonstrated in 2005, and represents significant advancements in robot mobility.
What are ASIMO's main features?	1) Lightweight and compact size 2) Advanced, flexible walking and running technology 3) Expansive range of arm movement 4) Simplified operation 5) People-friendly design

What is the size and weight of ASIMO?	• ASIMO stands 4 feet 3 inches tall (130 centimeters) and weighs 119 pounds (54 kilograms).
New Running ASIMO	

What are the major technological differences between the new ASIMO versus those of the previous running model?	Changes from the previous running model include:
	• Running speed: 3.7 mph (6 km/hour; previous running prototype: approx. 2.0 mph or 3 km/hour)
	  • Airborne time: 0.08 second (previous model: 0.05 second)
	  • Distance feet move forward while airborne: 2 inches (50 mm; previous model: 1/4" or 6 mm)
	• Normal walking speed: 1.7 mph (2.7 km/hour; previous model: 2.5 km/hour)
	• Operating time: 1 hour (previous model: 30 minutes)
	• Height: 4 feet 3 inches (130 cm; previous model: 4 feet or 120cm)
	• Greater range of movement
	• IC Communication card enhances recognition of people within its vicinity
	• Improved posture control and balance allows more twisting, bending, and pushing
	• New sensor technology allows continuous and in-sync movement

How fast can the new ASIMO run?	• ASIMO is able to run at a speed of 3.7 mph (or 6 km/hour). • The time with both feet off the ground when running at a speed of 3.7 mph is 0.08 seconds.
How does the new ASIMO run?	• Through proactive control of ASIMO's posture while both feet are off the ground, ASIMO is able to run at a speed of almost 4 miles per hour (6 km/hour). • Running in a circular pattern at a high speed (3.1 mph or 5.0 kph) was achieved by tilting the center of gravity of ASIMO's body inside of the circle to maintain balance with the amount of centrifugal force experienced. • For slalom running at 3.1 mph (5.0 kph), the center of gravity is moved toward the direction of the turn before the actual turning takes place – just like when a person skis with their skis parallel.

Why did Honda give ASIMO running capability?	• When ASIMO works in the same living space as people in the near future, it will be necessary to have the physical capability to quickly move and avoid any obstacle or danger. • To achieve quick movement using the entire body, the balance of the body has to be maintained dynamically. These running technologies will serve to assist ASIMO in effective real world movement.
How can the new version of ASIMO recognize the position of people within 360 degrees?	• The new ASIMO incorporates the capability to interface with an IC Communication card so ASIMO is no longer limited to relying only on front vision obtained via a visual sensor. • ASIMO can exchange information with an IC card, enabling ASIMO to recognize the position of the person with the card in a 360-degree angle. • By having a person hold or wear this card, ASIMO can interact better since the card can be programmed to include a name, affiliation, and other relevant information.
What powers new ASIMO?	• The new model of ASIMO is powered by a 51.8v lithium ion (Li-ION) battery. • ASIMO can operate for approximately one hour on a single battery.
How many joints does new ASIMO have?	• Because the word “joint” has a slightly different meaning for robots than for humans, the term “Degrees of Freedom” (DOF) is used instead. **Head** • Rotation, Up/Down (nodding) = 3 DOF **Arms** • 14 DOF (Left + Right) **Hands:** • 4 DOF (Left +Right) (not counting the joints for the 5 bending fingers) **Torso** • 1 DOF

	Legs • 12 DOF (Left + Right) **Total** • 34 DOF
What are some recent technological developments with the robot?	• ASIMO is the first humanoid robot capable of human-like running. • ASIMO can run at a speed of 6.0 km/hr (almost 4 miles per hour). While running, ASIMO's airborne time of .08 seconds approximates that of a running human. • Posture Control technology enables ASIMO to proactively bend or twist its torso to maintain its balance and prevent foot slippage and spinning in the air while running. • ASIMO can move objects using a cart by maintaining an appropriate distance from the cart making sure that its arms are not fully extended or its body is not touching the cart and can push the cart on the targeted course while maintaining good balance. • Autonomous Continuous Movement technology allows ASIMO to maneuver toward its destination without stopping by comparing any deviation between the input map information and the information obtained about the surrounding area from its floor surface sensor. • Enhanced visual sensor and force sensor technologies allow ASIMO to move in sync with people. ASIMO can give or receive an object, shake hands in concert with a person's movement and step forward or backward in response to the direction its hand is pulled or pushed.
Technology – Communications & Intelligence	
How is ASIMO controlled?	• ASIMO is controlled by a laptop computer or by a portable computer controller unit through a wireless network system. This permits more direct and flexible operation. A single operator can easily and fully control

	ASIMO's movements.
Can ASIMO also be controlled by voice commands?	• ASIMO can comprehend and carry out tasks based on simple voice commands that have been preprogrammed into its onboard memory.
Can ASIMO recognize people and obstacles?	• ASIMO utilizes IC Communications technology to recognize people within its vicinity. • ASIMO can also independently map its environment using its camera "eyes" and register stationary obstacles. ASIMO can store this data in an onboard map of its environment, then recall this data while walking in order to avoid these obstacles. • ASIMO can recognize moving pedestrians in its walking path and stop momentarily until these persons have cleared the robot's path.
How intelligent is ASIMO?	• ASIMO's intelligence lies in the technologies with which it is equipped, not in the ability to think or reason as a human.
Technology – Walking	
How does ASIMO walk?	• ASIMO walks by "prediction movement control," that is, predicting the next move and shifting the center of gravity accordingly. • ASIMO is very stable even when moving suddenly. Stored walking patterns for start/acceleration, steady speed, deceleration, stopping and turning are combined to achieve smooth walking. • ASIMO turns smoothly without pausing. Walking patterns are generated independently in real time by ASIMO itself, and foot placement locations and turning are carried out by the robot while walking smoothly in any direction.
Can ASIMO walk on slopes or walk backwards?	• Yes. ASIMO was designed to operate in a human environment. Currently, ASIMO can easily navigate a slope up to 30 degrees in maximum incline or decline and can also easily walk backwards.
Can it walk up and down stairs?	• Yes, ASIMO is the world's only humanoid robot that can ascend and

	descend stairs independently.
Can ASIMO navigate stairs of different sizes?	• With the rise and run of a staircase stored in its internal memory, ASIMO can easily navigate stairs of varying sizes and numbers of steps. Honda engineers are working on technologies to allow ASIMO to use its onboard cameras to independently measure the rise and run of a staircase for increased ease and flexibility of operation.
Does ASIMO ever fall over when walking, and can it stand up by itself?	• ASIMO can maintain balance while walking on uneven surfaces and slopes, and can also maintain balance when pushed or impacted to a certain degree. If pushed strongly enough, however, ASIMO could fall over. But because it is so light and compact, damage would be minimal. • ASIMO cannot get back on its feet by itself. Honda engineers are currently working on this capability.
How fast can ASIMO walk?	• ASIMO's walking speed is 1.7 mph (2.7 km/hour), and can now run 3.7 mph (6 km/hour).
Does ASIMO need to move its arms to maintain balance while walking?	• It is not necessary for ASIMO to move its arms for balance if walking at a speed of one mile per hour or less.
Structure	
What powers ASIMO?	• ASIMO is powered by a 51.8v lithium ion (Li-ION) battery. • ASIMO can operate for approximately 1 hour on a single battery. • About 3 hours are required to completely recharge ASIMO's battery. The battery can be recharged onboard ASIMO through a power connection, or the battery can be removed and charged externally. • ASIMO's battery weighs about 13 pounds (6 kg), and is located in its backpack.
How many cameras does ASIMO have?	• ASIMO is equipped with two cameras in its head. These camera "eyes" allow ASIMO and its operator to view the surrounding environment. These cameras can accurately judge distance from objects by using mathematical formulas and the stereoscopic nature of the cameras.

How many motors are used in ASIMO?	• ASIMO is equipped with 34 separate servomotors.
Applications	
What is the current use for ASIMO in the United States?	• Currently, there are two applications of ASIMO in the United States: • ASIMO is demonstrated daily in the Honda ASIMO Theater inside Innoventions in the Disneyland® Resort in Anaheim, California. *Say 'Hello' to Honda's ASIMO* is a fourteen-minute show designed to educate the general public about humanoid robotics and highlight ASIMO's current capabilities and potential use in a home environment. • ASIMO stars in "Step to Safety with ASIMO," a pedestrian safety program that teaches children safe ways to cross the street. This DVD video program is available free of charge to educators, police officers and safety advocates across the nation through ASIMO's Web site at asimo.honda.com.
What is ASIMO going to be used for in the future?	• ASIMO was created to be a helper to people in need. • While the robot is not yet ready for any specific applications of this kind, development is headed in this positive direction.
When will ASIMO be available for sale to the U.S. consumer?	• There are no plans at the current time to introduce ASIMO for sale or lease in the U.S.
Will ASIMO ever be used in a military application? How about space or under water?	• ASIMO will not be employed for any military purpose. • The current version of ASIMO was not designed to be used in a weightless environment such as outer space or in an under water environment.
Evolution of a Humanoid Robot	
What are the main differences between ASIMO and earlier models of Honda's humanoid robots?	*1) Lightweight and Compactness* • Redesigned skeletal structure • Reduced frame wall thickness • Specially designed control unit *2) Walking technology* • The use of Honda's intelligent Real-Time Flexible walking technology (I-Walk) permits continuous walking while changing directions, and high stability in response to sudden

	movement. • Unlike an earlier version called P3, which had to stop temporarily between changes of direction, ASIMO can change direction smoothly while walking. *3) Running technology* • Through proactive control of ASIMO's posture while both feet are off the ground, ASIMO is able to run at a speed of almost 4 miles per hour (6 km/hour). *4) Expanded range of arm movement* • By adding more joints, or "Degrees of Freedom" (DOF), ASIMO has greater range of arm movement, with a total of 14 DOF compared to 12 DOF in the earlier version. *5) Simplified operation* • ASIMO can be easily and fully controlled by a single operator through a laptop computer or portable wireless computer device.
What new developments do you see for ASIMO in the future?	• A team of Honda engineers is dedicated to the continued advancement of ASIMO and humanoid robotics. • At this time, we cannot comment on future projects or capabilities.
Question of the Hour	
Is ASIMO a "he," or "she," or an "it?"	• ASIMO is a humanoid robot, but still a robot. • It is most appropriate for ASIMO to be referred to as an "it," or simply as "ASIMO."