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Autonomous Walking Humanoid that Astonished the World – Honda's ASIMO

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1. Introduction

ASIMO, developed by HONDA Research Institute Japan Co., Ltd., is the world's first humanoid robot to achieve autonomous biped walking. Despite the fact that research on humanoid robots began in the 1960s, no successful cases of dynamic biped walking robots existed before P2.

ASIMO, which is an abbreviation of its product name "Advanced Step for Innovative Mobility," began being developed in 1986. Prototype 2 (P2) astonished the world when it was introduced to the public in December, 1996. A smaller, more multifunctional ASIMO, shown in **Fig. 1**, was unveiled in 2000.

In July 2002, ASIMO became famous around the world when it rang the New York Stock Exchange (NYSE)'s opening bell. In 2004, it was inducted into the Robot Hall of Fame at Carnegie Mellon University (CMU) [2].

2. Development of ASIMO

Masato Hirose, who went to work for Honda in 1986, began research on "Astro Boy," introduced by Nobuo Kawamoto, Honda's president at the time. Hirose had to start out by measuring human gait action because no researches were there to refer at the time [3-5].

He realized static walking using a two-legged experimental model, then designed dynamic walking similar to the human gait in 1988. His "bots" eventually were able to walk on uneven surfaces and to ascend and descend stairs by introducing stable walking techniques (**Table 1**).

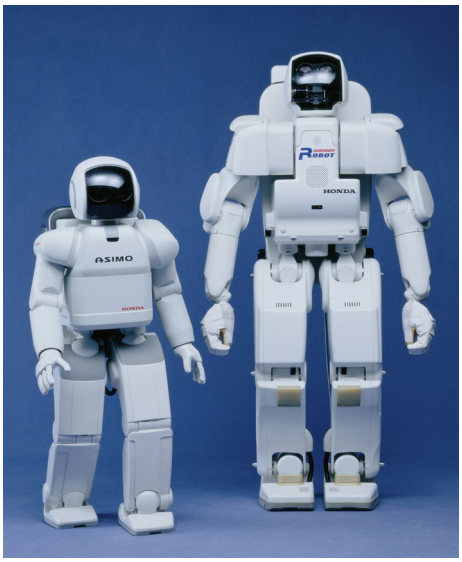
This was followed by the development of P1 to P3 humanoid robots with torsos and arms. P2, introduced first to the public, communicates wirelessly and carries a power supply on its back. P3 (**Fig. 2**), which was more compact and weighed less than P2, came along in 1997.

In 2000, ASIMO was born becoming more capable of adapting to human living environments as it dramatically became smaller and lighter than P3, emulating the size of elementary school children to help it fit in better with society. Predictive motion control methods and real-time pattern creation technologies were then implemented to enable more natural, flexible movement.

Decision-making and communication have also improved. By the time it was introduced in 2011, ASIMO in its latest form could run 9 km an hour, jump, and pass each other. ASIMO has also acquired face recognition, autonomous charging, sign language, guiding visitors, carrying trays, and cooperating among ASIMOs [1].

Source: courtesy of HONDA Research Institute Japan Co., Ltd. [1]

Fig. 1. ASIMO (photo is a type in 2001).



Source: courtesy of HONDA Research Institute Japan Co., Ltd. [3]

Fig. 2. ASIMO (left) and P3 (right).

Table 1. Development and specifications of HONDA's biped robots [1, 3].

Year	Model	Height (cm)	Weight (kg)	Walk pattern	Walk speed	Features
1986-1987	E0			Static	5 sec/step	First experimental model
1987	E1			Static	15 sec/step	
1987-1991	E1-E3			Static (E1, E2) Dynamic (E3)	1.2 km/h	
1991-1993	E4-E6			Dynamic	4.7 km/h	E4 manages irregular surfaces using 4 types of control. E6 ascends and descends stairs and slopes and strides over obstacles.
1993	P1	191.5	175	Dynamic		A torso and arms have been added.
1996	P2	182	210	Dynamic		It carries its power supply on its back and communicates without wires.
1997	P3	160	130	Dynamic	2 km/h	It is increasingly compact using distributed control.
2000	ASIMO	120	43	Dynamic	$\sim$ 1.6 km/h	Smooth actions are ensured through predictive motion control.
2011	New ASIMO	130	48	Dynamic	9 km/h	It is now capable of multiple autonomous actions.

References:

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