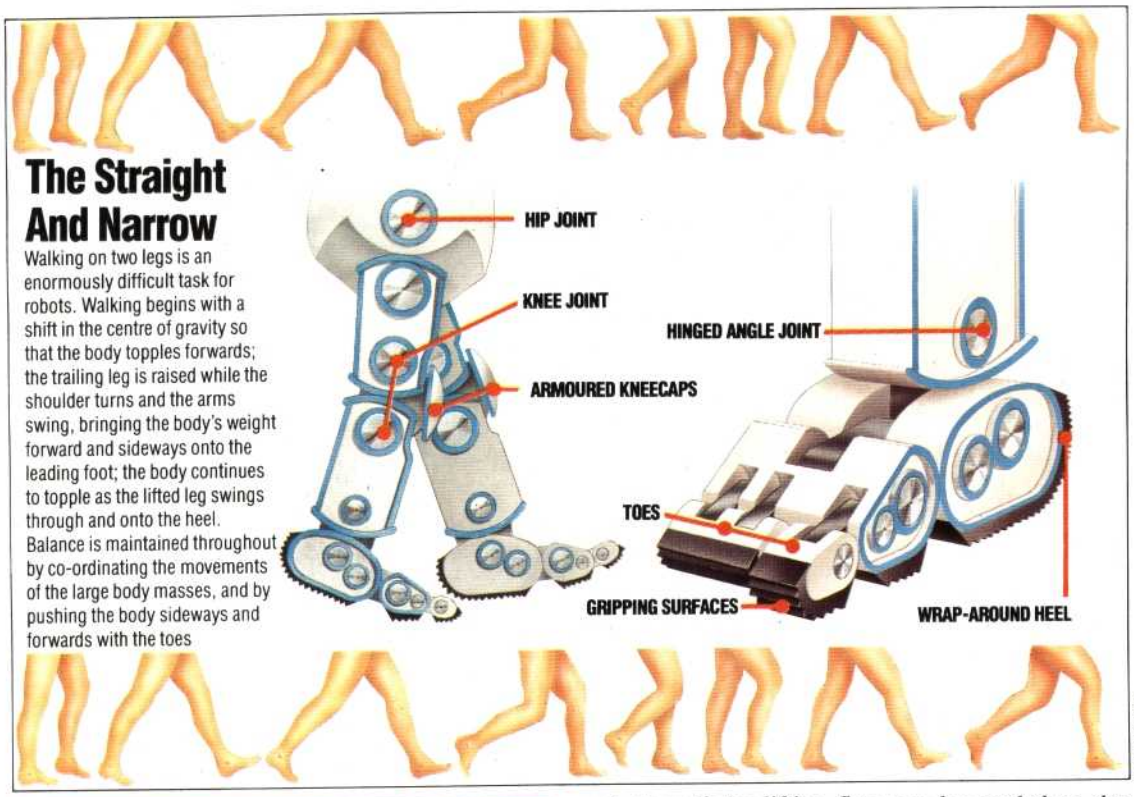
STEPPING OUT



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In the first part of our series on robotics we looked at how robots have developed from science fiction fantasy to the 'metal collar' workers of today's production lines. Now we discuss the three principal methods of robot movement and the most efficient means of controlling it.

Long before a child learns to walk it will be capable of picking objects up and will demonstrate intelligence in numerous other ways, but walking is a skill that takes a long time to develop and which involves considerable practice before it becomes automatic.

Robots can be made to 'walk', but the techniques involved are very different from the methods used by people. The robot may have legs, which it can swing backwards and forwards in an approximation of a human walk, but each of these legs is equipped with a foot that has wheels on its base. These wheels are fitted with ratchets to inhibit backward movement. So a robot of this type follows a set sequence of actions as it 'walks'. The disadvantage of this method it that it is difficult to develop a way of steering the robot; it will tend to move in a forward direction only and its movements will be imprecise.

A much better solution would be to make robots walk by lifting first one leg and then the other, as humans do, instead of simply swinging each limb through a limited arc. The major problem with this approach is that the robot must be able to balance on one leg as it walks. Various solutions have been tried: these include tilting the robot's body sideways and even moving the entire torso sideways on a rail so that the robot's centre of gravity is kept directly above the leg that is bearing its weight. If such a system were developed, robots could walk in an efficient manner. In theory, a walking robot could be designed to climb stairs and bring its owner a morning cup of tea. But in practice, although a robot that can climb stairs is quite feasible, a robot that 'knew' when it had reached the top of the stairs would be harder to develop because of the extra apparatus needed to detect the top step.

An alternative approach has been to mount robots on tracks. The advantage of this system is that it allows the robot to travel over rough ground. The British Army uses tracked robots for carrying out hazardous bomb-disposal duties; these machines can manoeuvre through debris and can cover reasonably rough ground.

Tracks are robust and are easily driven, but they have two main drawbacks. The first is that, as most robots are fairly small, so the size of the tracks is small and hence large obstacles cannot be