bring the robot back to a point it has already visited; in these cases the branches are 'pruned' and disregarded. The program then searches along the remaining branches to find the route with the least number of squares. It then adopts that path as its route to the centre.

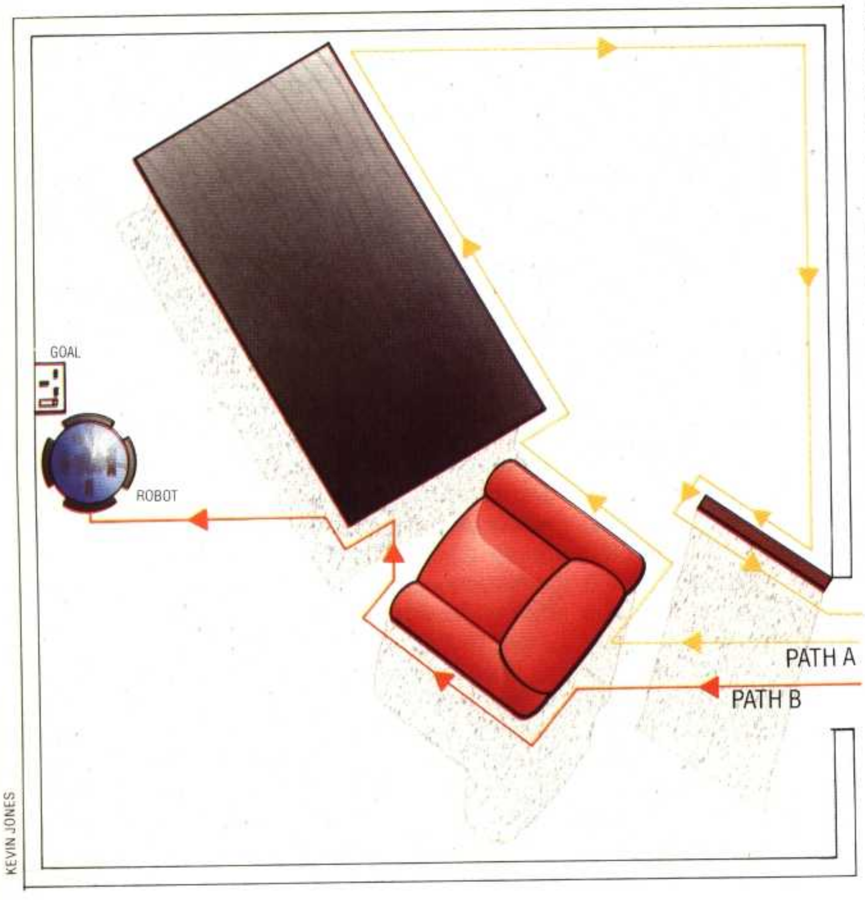
This method can be adapted to provide a more efficient strategy. The sensors on the robot are crucial to its success. For instance, simple mechanical touch sensors require the robot to actually bump into each wall to map its path; proximity sensors can detect a wall without actually touching it and a distance sensor can detect the position of a wall at the end of a long clear path in the maze. Obviously, equipping the robot with four sensors instead of just one would enable it to 'look' in all four directions at once and would remove the need to make it turn around in each square.

AROUND THE HOUSE

So we can see that a robot can act 'intelligently' as it negotiates a maze. In many respects, the problem of constructing a robot that can find its way around your home is very similar. The robot must use sensors to work out the positions of all the objects in a room, and it must then plan a route that will take it round any obstacles to its destination. The additional problems involved in this type of intelligent movement stem from the fact that a room is much more complex in design than a maze. The typical room is not neatly divided into squares, nor do all its contents remain in the same place. Your tea-making robot may learn the position of various objects — but if you move a chair, or if a cat sits on the floor, the robot must then modify its chosen path.

This problem can only be solved by having the robot make continual use of its sensors to update its internal map. The problem of the cat requires more thought because, as robots do not know anything about cats (or about people, for that matter), it is difficult for it to work out what to do at its first feline encounter. (No doubt the cat will have the same problem when it first meets a robot.) The best solution is to fit the robot with a movement sensor — which is a distance sensor that responds to variable distance measurement and can thus cope with moving objects. Once the moving object has been detected, the best thing the robot can do is to stop moving altogether until the object itself stops moving or goes away. This may not sound very intelligent, and is certainly less friendly than going up to the cat and stroking it, but such an action is very similar to the reaction shown by many animals, which 'freeze' when they detect moving objects.

The whole subject of intelligent movement is thus intrinsically linked to the use of sensors in conjunction with a computer program. A robot without sensors will not be able to move intelligently, and the more sensors a robot is equipped with, the better its knowledge of the world will be. It is this knowledge of the world that enables the the robot to exhibit signs of intelligence.



A Room Of One's Own
Finding a way around unknown objects is never easy. Path A shows the track of a simple household robot trying to find the electrical socket. Its only object avoidance algorithm (known as 'wall-following') is to follow the edges of things while its short-range sensors seek the object. This primitive method can be very successful in simple surroundings, but is susceptible to traps and pitfalls of the kind shown here.

Path B shows the track of a similar robot with a slightly improved algorithm: when it has to turn along the side of an object it prefers to turn through the smallest possible angle since this will reduce the amount of 'back-tracking' that it does. This simple change greatly reduces its vulnerability to traps and allows its scanning sensors to control its behaviour more effectively