magnetic fields. These fields are often used in industrial applications where a robot must follow a fixed path through a warehouse or factory floor. Special cables are buried in the floor which leave a magnetic 'path' for the robot to follow.

Control of the floor robot is generally handled through a set of specially-written program routines. These handle the sending and receiving of information over the cable link from the computer's user port to the device. In the case of the BBC Buggy four bits are used to control the motors. Data is sent from the Buggy along the same cable. The analogue outputs from both the light sensor and the bar code reader go to the analogue port, and the two collision detectors are connected to two other input lines on the user port.

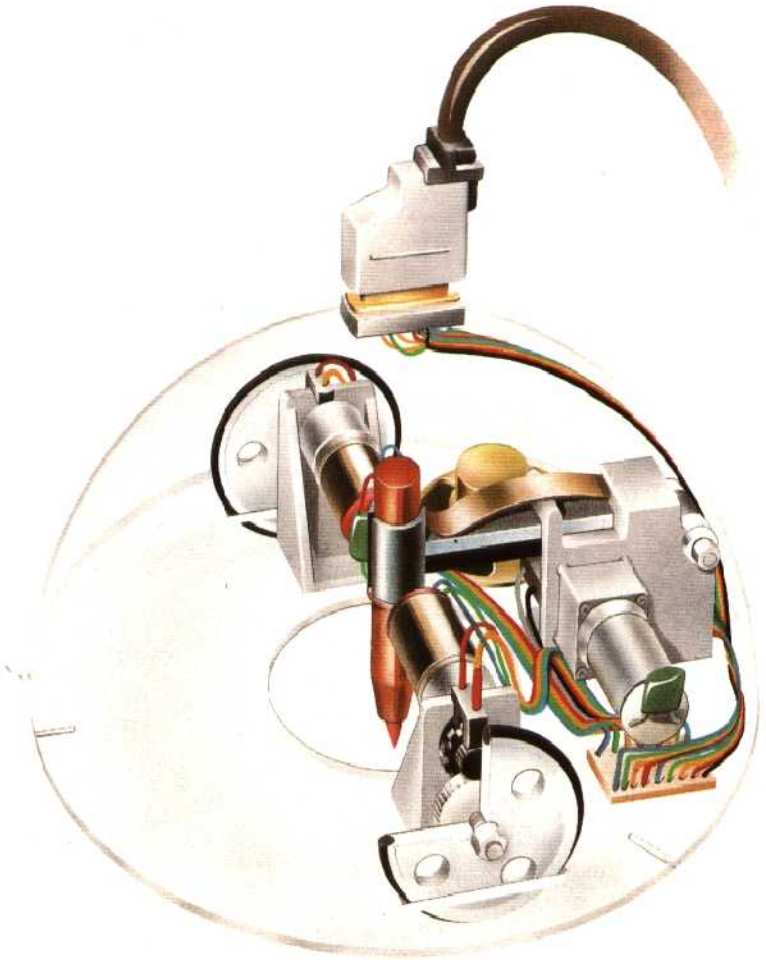
An I/O port such as the user port can be examined by looking at a certain location in the computer's memory map. The BASIC command PEEK is generally used to read the current contents of the location. To alter the contents, in order to change the direction of one of the motors, and turn the robot, for example, the programmer must alter the value of the appropriate bit in the location. The command POKE will achieve this in a BASIC program.

The analogue information can be examined in much the same way, provided the computer being used has an analogue-to-digital converter built in. If no such device is available then an interface unit must be added to the robot which converts the analogue signals to digital information before sending them back to the computer.

A turtle is really a form of floor robot intended for use in conjunction with the LOGO language, though the distinction between a robot and a turtle is becoming somewhat blurred (see page 164). Many of the latest turtles are equipped with collision detectors, just as many of the floor robots are being fitted with pen holders to enable them to act as turtles. The idea of being able to create large-scale drawings by moving a wheeled pen over the surface originates from the teaching of the relationship between distance, angle and shape. If a person moves 10 units forward, turns left, moves 10 units, turns left, moves 10 units, turns left and moves another 10 units, he will have walked around a square. To illustrate these shapes and the relationship they have with movement we can attach a pen to the robot or turtle and create the shape on paper.

The BBC Buggy comes in the form of a construction kit, so you have to assemble it before you can explore the world of robotics. The Buggy is based on the commercially available Fischer Technik system and so can be expanded and enhanced very simply.

Putting together a device like the Buggy is an education in itself. A lot can be learnt from examining the way the various pieces go together. However, the real learning begins when the user tries to take control of his new 'toy'. Although many of the commercial floor robots come with controlling software it is much more fun to write your own. A completely new approach to programming is required — that of control.



DAVID WEEKS

Dedicated Robot
A turtle is a dedicated form of robot which draws on the floor with a retractable felt-tip pen under the instruction of the computer. Turtles are usually associated with the LOGO educational language (see page 164), though they can be driven by BASIC

While the robot is active the program must constantly monitor its sensors to see whether it has found a line on the floor, detected a strong light source, bumped into a chair and so on. The instant the detector signals something the computer must react to protect the robot from potential damage. Programs of this type are typically called 'real-time' because their responses must be immediate.

In theory there is little difference between a program that can allow a floor robot to roam around a room without hitting objects and one that can control a power plant. The techniques learnt by playing with devices such as the BBC Buggy can also develop an understanding of artificial intelligence. Programs can be written that allow a floor robot to carry out a pre-determined task until a detector senses that its batteries are running low. The robot then searches for a suitable power supply to recharge itself, so that it can carry on functioning.

The next generation of floor robots will offer even more remarkable facilities. They will probably be equipped with grab arms to allow them to fetch and carry small loads. Light sensors may also be replaced by miniature solid-state cameras that will allow the robot to 'see' where it is going. Speech synthesis units will allow the robot to communicate with its operator and speech recognition will open a new channel of control over the robot's actions.