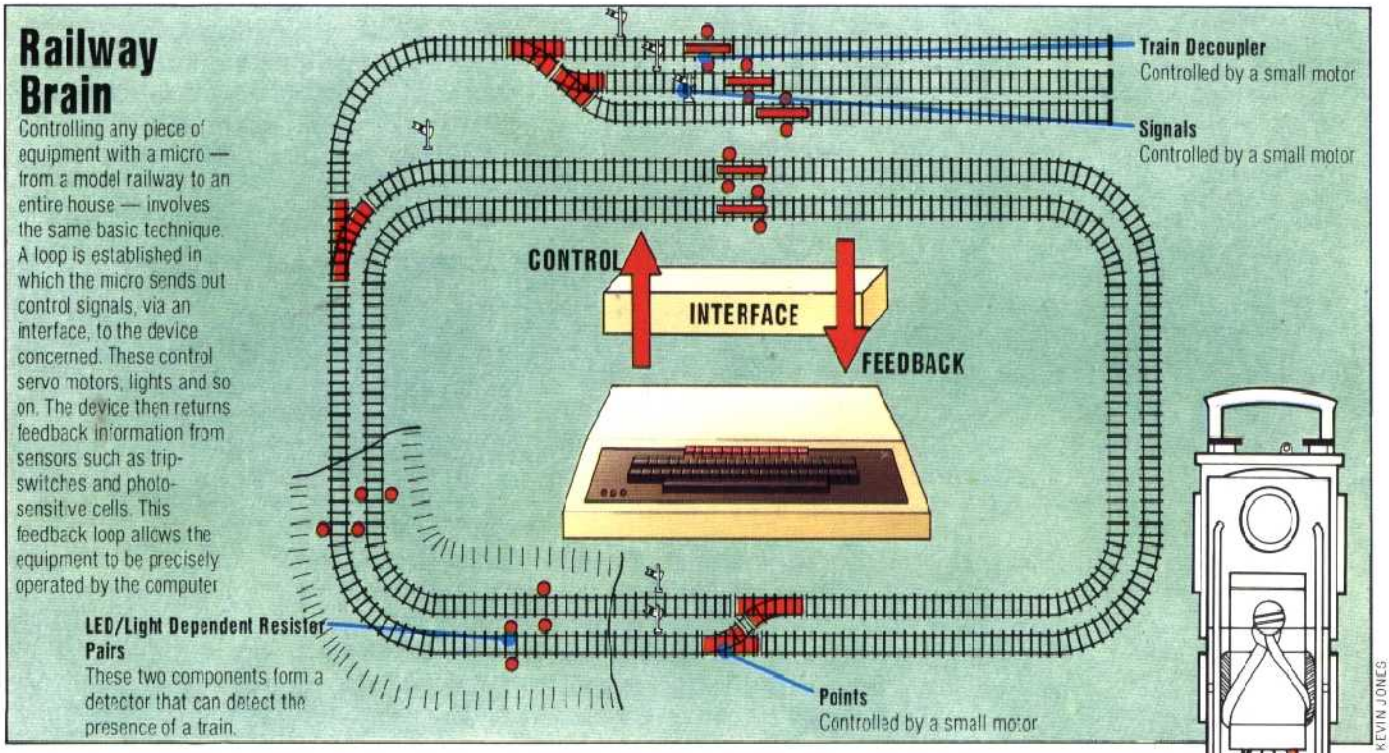
Railway Brain

Controlling any piece of equipment with a micro — from a model railway to an entire house — involves the same basic technique. A loop is established in which the micro sends out control signals, via an interface, to the device concerned. These control servo motors, lights and so on. The device then returns feedback information from sensors such as trip-switches and photo-sensitive cells. This feedback loop allows the equipment to be precisely operated by the computer



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type of *on/off signal.*

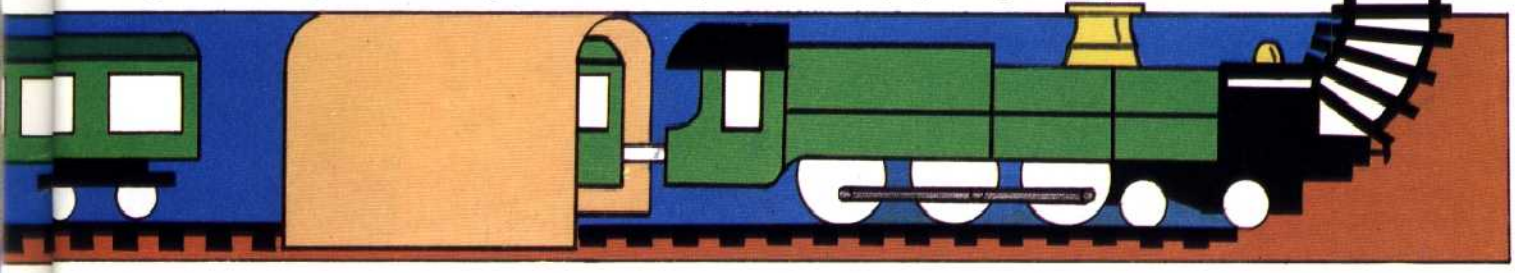
A more useful, but slightly more complicated type of feedback gives an *analogue signal.* Such a signal can be one of a range of values and so can be used to measure how hot it is, how far an object has moved or turned, how heavy something is or what voltage a battery is giving. A device that can accept this sort of signal is an *analogue-to-digital converter* (A/D for short), so-called because it takes the varying range of values from the equipment being controlled (the analogue signal) and converts these into a digital form that the computer can understand.

Having feedback makes a big difference to what can be done under computer control. If a motor is turning a wheel, the computer might be able to estimate how far the wheel has turned in a certain time. This wouldn't work, however, if a load is put on the wheel or the batteries driving the motor are going flat, because the wheel would turn more slowly. An optical sensor could tell the computer each time the wheel completed one revolution, so that the computer could keep track of it.

Some types of electric motor made specially for control uses have a kind of feedback built in to them. This means the computer sends a signal telling them to move to a particular position and the motor keeps working until it has reached it. There are two main types of such motors: *stepper motors* and *servo motors.* A stepper motor can spin continuously, like an ordinary motor, or it can be stopped at any position. However, it lacks power and so can only cope with small loads. Servo motors are powerful but can only turn through a small angle—usually just over 90 degrees. This is often converted into a push/pull type of movement. Both stepper and servo motors need special control units to make them work with computers and these are not available for many of the less popular makes of home computer. Servo motors are used in many robot arms. A number of small robot arms are available that can interface with home computers, but they are very expensive. It is possible to build them from a few servos at lower cost.

The final category of computer-controlled device that we will consider here need a varying voltage to control them. One example of this is a small electric motor that will spin at different speeds, depending on what voltage is applied to it. The opposite of an A/D converter, a digital-to-analogue converter (or D/A for short) changes the digital signals the computer uses into varying voltages. This could, for example, be used to produce sound by connecting it to a loud speaker.

Using microcomputers to control other equipment is just like writing your own software. You have to combine a good idea with some technical knowledge, and a large amount of time. Often the results aren't up to commercial standards, but it is much more fun 'doing it yourself' than buying mass produced products.



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