POWER SUPPLY

By connecting a servo motor to the user port of your computer, using the buffering system that we have developed in the Workshop course, it is possible to undertake a variety of control applications. We look at what servo motors are, and suggest some uses to which they can be put.

There are three types of electric motor — direct current, stepper and servo. A *direct current* (DC) motor can be easily controlled by a computer, but tends to be inaccurate if it encounters any resistance. In such a situation, the speed of the motor is reduced and the controlling computer cannot keep track of its position.

A *stepper* motor does not have this problem, as it moves through a fixed angle (for example, 7.5°) each time it is given a single current pulse. By counting pulses, and assuming that the motor is never overloaded, the computer can calculate the motor's position. Stepper motors are widely used in computer-controlled systems — robot arms, lathes, sorters, etc. However, the control pulses also deliver the power to the system, and the motors therefore require specially-built drivers and are relatively expensive.

Small digital *servo motors* are easily obtained from modelling shops, since they are commonly used in radio-controlled aircraft, boats, cars, and so on. These motors vary in size from about half that of a matchbox to almost ten times that size. Prices generally start at £8. Some servo motors are remarkably strong — capable of delivering more 'torque' (the word used to describe any force causing rotation) than most people could produce using a large screwdriver. Even the least expensive of these are suitable for making small robot arms, etc.

A small digital servo motor, such as a Futuba FP-S126 or an Axoms AS-1, contains a feedback potentiometer and a tiny DC motor linked — via a series of gears — to a 'horn'. The latter is a protrusion from the motor onto which levers, sprockets and so on can be attached. The motor is also ideal for setting up a looping feedback system with a computer, as the motor case also contains all the circuitry to do so, as well as an integrated circuit controller chip.

A typical model-maker's digital servo motor is powered from a five volt supply, and its angle (position) is set through a separate control wire. A one-millisecond (1/1000) pulse will move the horn in one direction, while a two-millisecond pulse will move it the same angle in the other direction. Variations in the angle moved are proportional to the pulse duration.

However, the motor will remain active only for about 20 milliseconds after the pulse, when it 'relaxes' and returns to its original position. To maintain the lever at a particular angle, therefore, the control pulse must be repeated at a frequency of about 50Hz.

Servo motors are normally used to move levers, and so on, but they can also be used for linear motion. If the potentiometer is decoupled from the gear train and centred, the motor will rotate continuously. In fact, the speed it rotates at is then governed by the pulse duration.
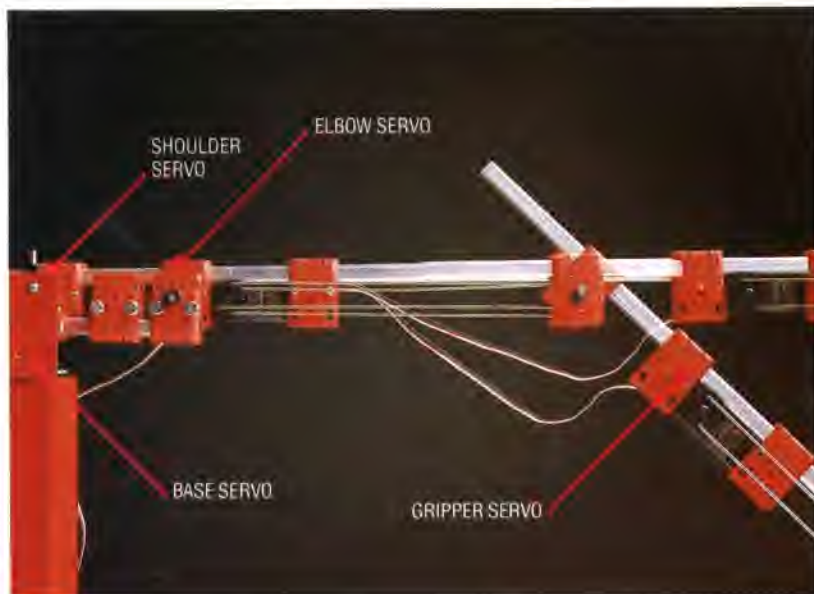
COMPUTER CONNECTION

When servo motors are directly connected to the user port of a computer, then wiring errors can damage the delicate internal mechanisms of the machine. Therefore, a buffering system must be used, and the buffer and output boxes built earlier in Workshop (beginning on page 514) are ideal for this. You should connect the motor's power supply wire to the positive socket (red) of one of the lines of the low voltage output box. The common ground wire should be connected to the negative socket (black).

If the motor control wire has been connected to data line 0 on the computer user port, then the motor itself can be controlled by sending the appropriate pulse sequences to the user port data 0 line. A pulse is sent by raising data 0 to five volts, by storing a binary 1 in data 0. A countdown loop is then used to wait for the desired length of time before lowering the output again by storing a binary 0 at data 0.

Beast Of Burden
The Beasty robot arm (see page 770) is powered by three servos (base, shoulder and elbow rotations) with an optional fourth servo to drive the end effector. The servo motor is ideal for robot arm use precisely because it can be moved and then locked in position

SHOULDER SERVO
ELBOW SERVO
BASE SERVO
GRIPPER SERVO

IAN McKINNELL