Science & Technology Equipment News

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For Primary Schools and Teachers of S1/S2 courses

STS National Support Services in **Science, Technology, Safety**

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Don't talk to me about life[1]

"I've been ordered to take you down to the bridge. Here I am, brain the size of a planet and they ask me to take you down to the bridge. Call that job satisfaction? 'Cos I don't."[1]

This Newsletter revisits control technology, this time at the request of a primary school teacher. We were asked to evaluate an inexpensive robot arm from CPC, a supplier of educational, electrical and electronic components. In the past we have not been keen on robot arms, as they tended to be expensive and of limited use. After trialling this particular device, however, our opinion may now be moving in their favour for some work at 5-14.

Footnote 1. The quotations are from Marvin the Paranoid Android in the *Hitchhiker's Guide to the Galaxy* by Douglas Adams. One of Marvin's websites is at : http://www.kodie.demon.co.uk/marvin.htm

Curricular contexts

Controlling devices, sensing and collecting data are all referred to in the National Guidelines for Environmental Studies 5-14. For example in the Guide for Teachers and Managers:

ICT: Controlling and Modelling - Main features of Strand

Control Hardware - *Knowledge of terms and uses - Input and output sensor/ devices* (Levels A, B, C, D, E & F)

Technology Designing and Making - A way of Exploring Space. *Processes and how they are applied - Developing ideas and creating solutions* (Levels C & D).

And, in the guidelines for science:

Science: Energy & Forces - Properties & Uses of Energy

Analyse the functions of everyday electronics systems in terms of input and output conditions.

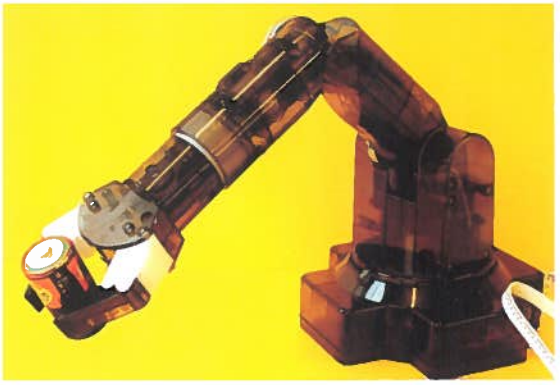

Figure 1 An assembled CPC robot arm kit

Why use a robot?

Whilst there are many devices that could be used, a robot arm will no doubt be enjoyed by children as part of their space war and computer game fantasies. This particular robot arm can be used with the keyboard supplied or programmed, with the addition of software and an interface, to work from a computer.

Children could view the arm as part of a life size robot, like *C3-P0* from *Star Wars*. Can they think of a process where robots are used? Examples include cold stores, deep sea diving bells, nuclear power stations, space stations etc. Is an automatic washing machine a robot? Can robots be useful in a social context or take on human characteristics as in the film AI? Perhaps they could, or already do, clear land mines, work in other hostile environments or stack shelves in the supermarket. Could the class design a robot to help people with disabilities?

The word robot was coined from the Czech *robota* meaning drudgery and was first used in Karel Capek's play *RUR* (*Rossum's Universal Robots*).

The Oxford Dictionary definitions offered for a robot are:

"1. A machine with a human appearance or functioning like a human.

2. A machine capable of carrying out a complex series of actions automatically.

3. A person who works mechanically and efficiently but insensitively".

This last definition was used by Erich Fromm in *The Sane Society* (1955) when he suggested that society was approaching a crossroads whereat - *"The danger of the past was that men became slaves. The danger of the future is that men may become robots."*

Human interest in the mechanical copying of animal or human actions goes back many centuries. From the work of Hero's *Automatic opening temple doors* in 60 AD to the automata in 14th century clocks and thence to recent TV adverts for the Renault Picasso.

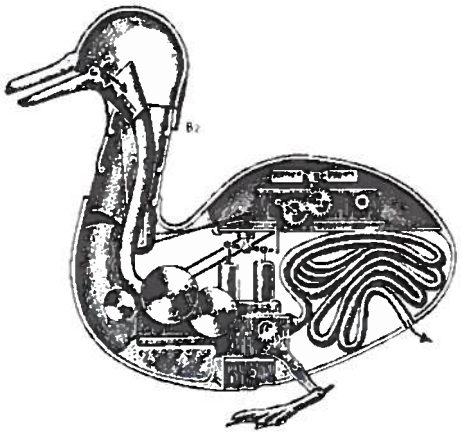

Figure 2 Vaucason's duc

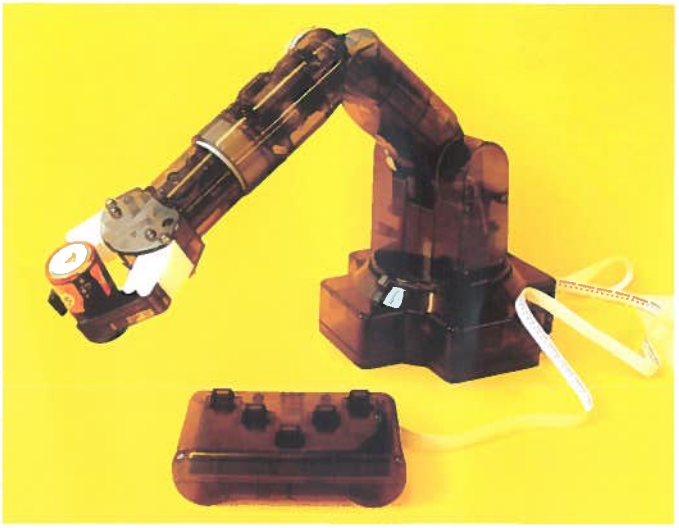

Figure 3 Robotic arm connected to the keyboard.

Early in the 18th century Vaucason designed and built his famous duck. Even within today's technology this would be a marvellous accomplishment, for the period it must have seemed to possess magical qualities. Contemporary descriptions of the duck assign to it the ability of moving its body, flexing its wings so that all the feathers work in unison, quacking, drinking water, eating grain, and excreting the results - all in perfect mimicry of the living animal.

Lend a Hand

The robotics arm is delivered in kit form and at first sight the assembly of all the parts may look a tad complicated. Anyone who has assembled an IKEA or MFI bookcase, however, should find assembly of the arm reasonably straightforward. A helper would come in handy (groan!).

The instructions are clear and easy to follow. You will end up with a few spare self-tapping screws but, don't worry, they really are spares. Depending on your experience, complete assembly could be done in about 2 hours but it is better take your time and make sure each part works properly as you go along. The beauty is that you can make up parts when you have a spare half-hour and leave them assembled until you have your next little bit of 'free' time.

Fiigure 1 on the front page shows the completed model holding a D cell to give some idea of scale. The body parts of the robot are made from smoked acrylic, the gear wheels are plastic and there are five motors each with a gearbox. The base of the robot holds the power source, four D type cells. The weight of these 'batteries' helps stabilise the arm. The keyboard (Figure 3, top right) is also made from smoked acrylic with five labelled keys; individual named keys operating different parts of the arm.

A perfect put-down

The most obvious use of the arm with the keyboard is to use it simply as a *pick and place* robot. Imagine processed parts being removed from an assembly line and placed on a test rig or placed in a box for packing. Now your challenge, should you wish to take it, is to move the D cell from a paper circle and place it in a box. Any box will do, but if you wish the robot to retrieve the battery the box should be big enough to accommodate the gripper and wrist. The battery could then be taken from the box and returned to the circle of paper.

This is where the children come in. What other simple tasks could we undertake with the arm? For example, since the gripper can be turned through 180 degrees, could the arm be used to fill or empty a cardboard or polystyrene drinks cup?

ICT applications

To use the robot arm with a computer, an interface board is needed and one is supplied with the *MOVIT LAB* software. The interface uses the same socket as the keyboard on the base of the robot. There are also two light sensors attached to the board. Figure 4 below shows the interface board and one sensor. The sensors act as switches and a sample program using sensors is given in the demonstration (*demo*) mode. The software to program the arm is written in a high-level computer language, which is easy to understand and use.

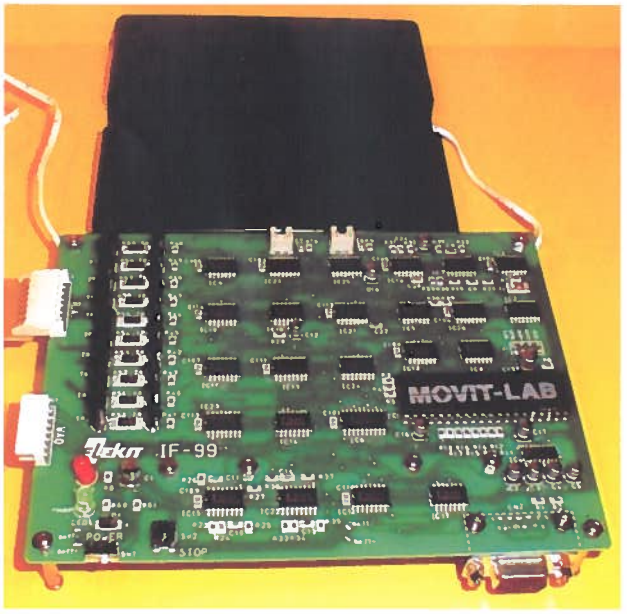

Figure 4 Interface and sensor

Wealth warning! *The software reviewed here is only available for Windows '95 or '98.*

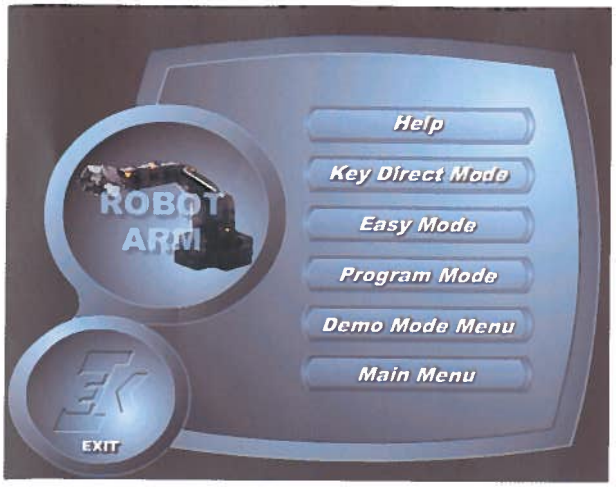

Figure 5 Screen choice display or menu.

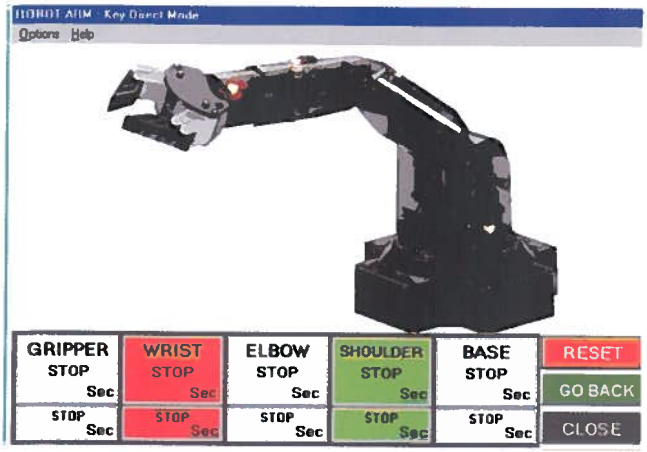

Figure 6 Screen display when in keyboard simulation mode.

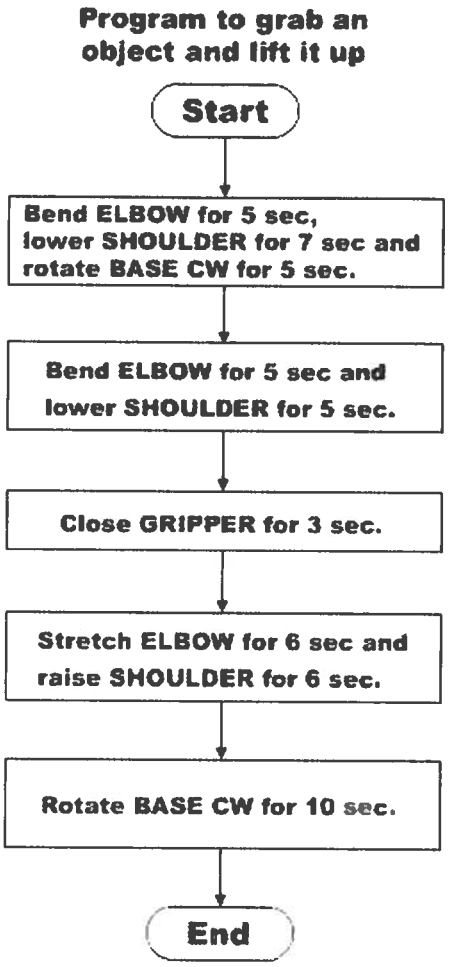

Figure 7 Flowchart display.

Those familiar with Basic or LOGO should have no difficulty in writing programs. When the software is loaded, a screen prompts the user to choose a mode of operation (Figure 5).

Keyboard direct mode enables the various parts of the arm to be activated in a similar way to the keyboard. A demonstration program in the software gives an idea of the simple commands needed to grab and lift an object.

For those who like to use flowcharts, Figure 7 provides an example of a chart for this demonstration program. An added attraction of the *demo mode* is a thumbnail video clip showing the arm in operation.

Is it worth it?

The robot kit, leaving aside time for assembly, appears to be a good buy. Our only concerns are whether the device is robust enough to stand up to a lot of work with pupils, and the lack of Apple-Mac software. With those reservations in mind we think that the arm, either on it's own or with the software, is quite a good buy for 5 -14 work in science, technology and ICT. The software may seem expensive. But, with both arm and software all of the control outcomes shown in the 5-14 guidelines can be covered.

If the pupils are also considered to be responsible enough to carry out the assembly of the robot, this will certainly contribute to a few more ticked targets. As a bonus, for those working with *Basic Stamp*, *PICAXE* or *PIC Logicator*, this is a marvellous opportunity to add another model for work in S1/S2, Standard Grade or possibly in some Intermediate courses.

We trust that this Newsletter has included enough background material to indicate also the many possibilities for setting the science and technology of robotics in appropriate historical, commercial, social and ethical contexts.

Supply details

The robotics arm itself is available from CPC Components catalogue number HK00312 and costs £51.04. The interface and software for Windows is known as MOVIT-LAB, and is available from the same source at £129.97. Although details are also available on the CPC website this does not seem currently to have an online shopping facility.

CPC contact details:

CPC, Component House, Faraday Drive, Fullwood, Preston, PR2 9PP. T: 08701 202530 F: 08701 202531 E: sales@cpc.co.uk W: www.cpc.co.uk

Components & Materials

Item	Description	Price
593	Miniature motor, 1.5V to 3V, 2mm dia. shaft	30p
614	Miniature motor, 3V to 6V, 2mm dia. shaft. Both motors above can be used for project work but they run at fairly high speeds, some gearing will be required. See worm/gear, item 811.	45p
621	Miniature motor, 1.5V to 3V, now with 8 tooth pinion. The open body of this motor makes it ideal for showing how such a motor is constructed	25p
798	Pack of 24 gears, 6 each of 12, 20, 30 or 40 teeth, dia.15, 22, 32 and 40 mm. 12 tooth gear fits motor shaft and 40 tooth gear push fits in cotton reel	£2.00
799	Pack of 24 cams, 6 of each of 4 shapes	£1.00
800	Pack of 100 wheels, 39 mm dia., assorted colours, 3 mm axle hole	£5.25
811	Worm and gear, 34 to 1 speed reduction	35p
817	Axles 3 mm dia., nickel plated, round ends, push fit on SSERC plastic wheels, gears and pulleys: 70 mm long, per pack of 4	40p
818	As above but 95 mm long, pack of 4	40p
819	As above but 12 mm long, pack of 4	40p
820	Worms to fit 2 mm electric motor shaft, pack of 5	£1.00
821	Reducers 3mm to 2mm enables gears, pulleys and wheels, to be fitted to motor shaft, per 5	25p
867	Reducers, 4 mm to 2mm, as above, per 5	25p
868	Reducers, 4 mm to 3 mm, as above, per 5	25p
710	Sonic switch. SOLD OUT	
723	Microswitch miniature, lever operated	40p
822	Plastic toggle switch, low voltage	40p
688	Crocodile clips, red, miniature, insulated	5p
759	As above, but black.	5p
788	Crocodile leads, assorted colours, insulated croc. clips at ends,36 cm long. Pack of 10	£1.35
835	2 x AA Cell ('battery') holder	15p
845	2 x C Cell ('battery') holder	20p
729	Battery connector, PP3 type, snap-on press-stud, suitable for Items 835 and 845	5p

Item	Description	Price
789	MES (miniature Edison screw) bulbs 3.5 V	10p
691	MES battenholders for above.	20p
866	Lens end lamps, 1.2 V MES. Ideal for use where a narrow, concentrated beam of light is needed. Bargain pack of 100	£3.50
508	LED (light emitting diode) 3 mm, red, per 10	50p
761	LED 3 mm, yellow, per 10	60p
762	LED 3 mm green, per 10	60p
790	3V buzzer (works with solar cell see Item 838)	55p
846	Sound module with 'melody' chip	£1.00
838	Solar cell, 100 x 60 mm, 3.75 V per cell, max.	£2.10
839	Solar motor, body 25 dia.12 mm long with shaft 2 mm dia 6 mm long	£1.70
840	Solar pack : one of each solar cell, solar motor propeller (801), and 3 V buzzer - with notes.	£3.75
836	Motor mounts, plastic, push-fit with self adhesive base pad for SSERC motors 593 & 614, 10pk	£2.35
801	Propeller, 3 blade, to fit 2 mm shaft. Blade 62 mm long	35p
792	Propeller kit with hub and blades for ten 3 or 2 bladed propellers	£3.50
794	Cotton reels (for making buggies, rubber powered tanks etc.) pack of 20*.	75p
796	Pack of 20 pulleys, 5 of each of 10, 20, 30 and 40 mm diameters.	£2.50
837	Ring magnet, 40 mm o.d., 22 mm i.d.	35p
815	Ceramic square magnet, 19 x 19 x 5 mm	15p
823	Ceramic magnets, poles at ends, 10 x 6 x 22mm	12p
861	Bimetallic strip, 10 cm length	30p
882	Quartz clock movement , dimensions 56x53x17mm, with wall hanging bracket, Suitable for dial thickness up to 10mm. Includes plastic hands suitable for dial diameter to 200mm. Requires an AA battery. See CD Clocks, Newsletter 18.	£1.75
884	Onager kit. Wood cut to length etc.	£2.00
885	Chariot kit. Templates and parts.	£2.00

Item 794* **Not *200 as previously stated in error*

An interactive, fully illustrated, version of this list is posted on the SSERC site at:

http://www.sserc.org.uk/Members/Primary/Surplus/body.htm

This newsletter and a number of previous issues are posted in web page format on the Improving Science Education 5-14 site at: **www.ise5-14.org.uk**

Prices do not include VAT which will be charged at the ruling standard rate. Cash with order only when total value is less than £5 and please add £1 for carriage solely to these small orders (except where an inclusive price is indicated eg kits, etc). For orders totalling more than £5 please do not send payment etc but await delivery and then pay on our advice note or invoice.

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