School Dinner Money Microcontroller Projects!

Two microcontroller projects for less than the price of a school dinner!

by Clive Seager

Fig. 1 8 pin re-programmable PIC microcontroller

New 8 pin Microcontroller

Microchip have recently released a new low-cost 8 pin PIC microcontroller called the PIC12F629. This microcontroller is constructed from the new FLASH memory technology, which means it can be re-programmed over and over again, making it ideal for use in educational projects. It's low cost also make it far more accessible for class work. This article describes two simple projects using this microcontroller that can be constructed for less than the price of a school lunch!

Why use an 8 pin microcontroller?

- Very low cost (approx 85p)
- Re-programmable and re-usable
- Simple circuit construction
- Easy PCB layout that can be drawn by hand if required.
- 5 or 6 input/output pins, including one analogue input (exact configuration depends on the educational programming system used)

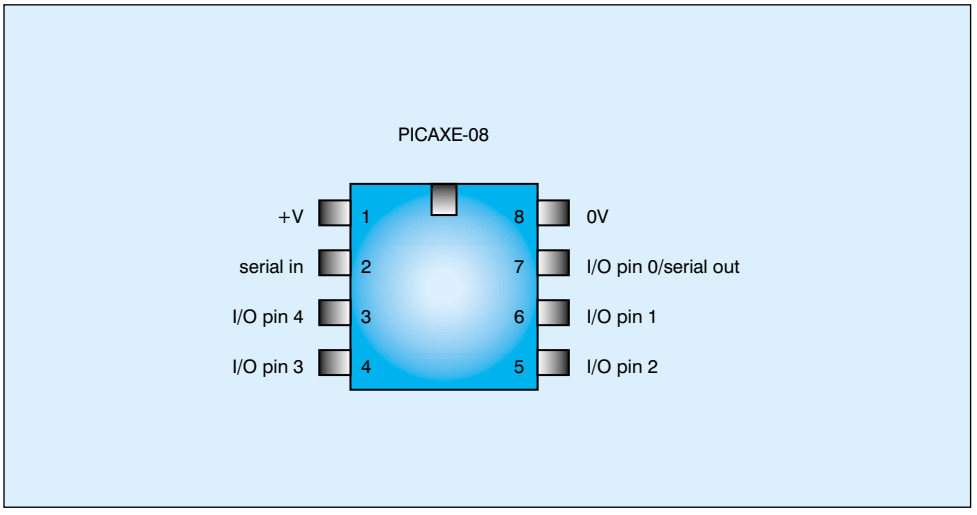


Fig. 2 Microcontroller layout (PICAXE system)

Microcontroller Layout

Figure 2 shows the layout of the PIC12F629 when used with the PICAXE system. Legs 1 and 8 provide the power (2.5-6V) connections, whilst the other legs provide the input/output connections. Simpler educational systems such as the TEP Chip Factory and PIC Logicator pre-define which legs are inputs and which are outputs, but more versatile systems such as the PICAXE allow you to configure the legs so that you can vary the number of inputs to outputs as appropriate for your project. Pin 1 also has an analogue input capability for connecting analogue sensors such as LDRs and thermistors.

Beware: Microchip do not use the same 'leg' numbers as the 'input/output pin' numbers and so make sure your students understand the difference between the input/output pin (I/O pin) number and the physical leg number!

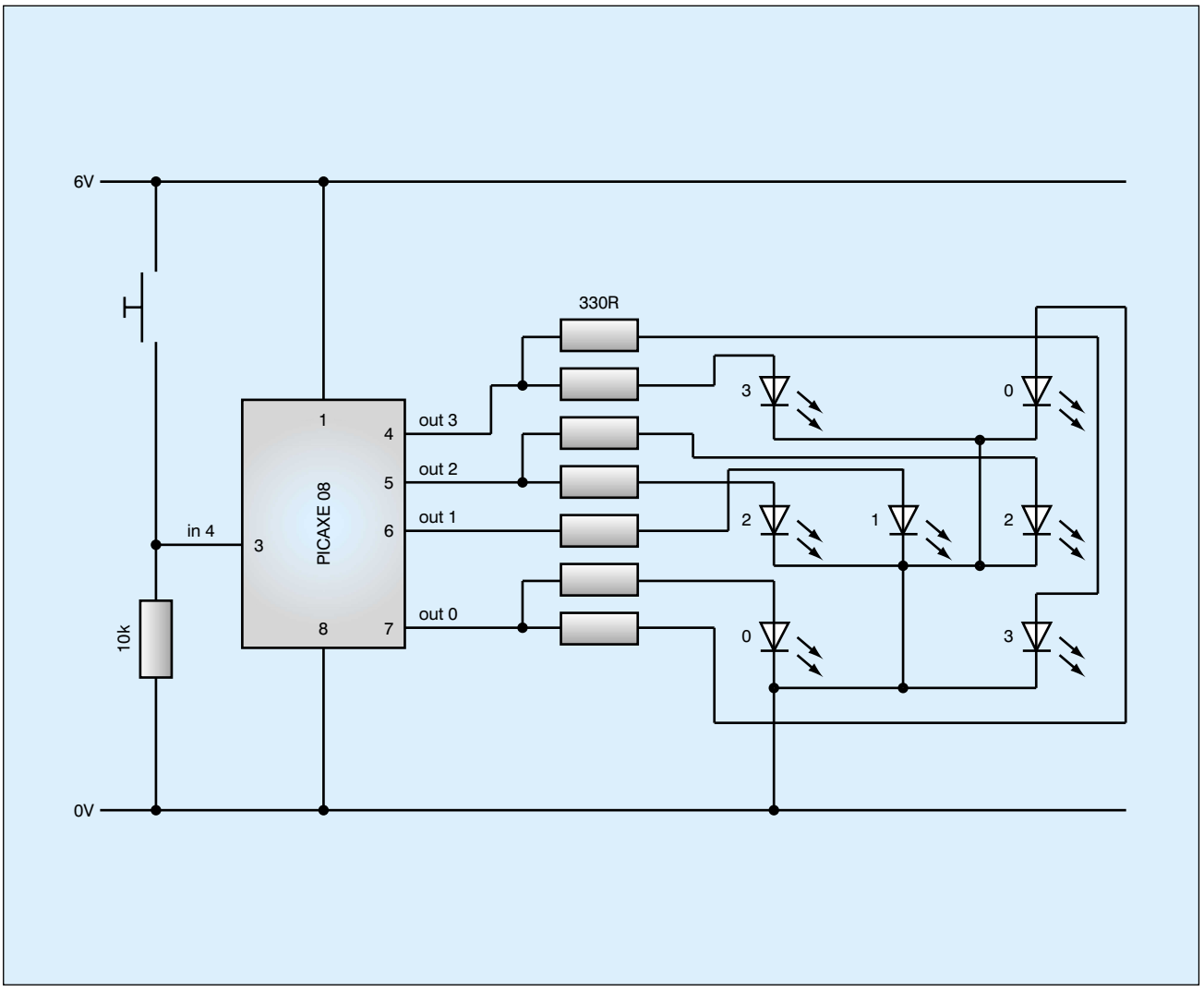
Sample Project 1 – An Electronic Dice

This project demonstrates how the microcontroller can be used to switch output LEDs on and off to make an electronic dice for a game. Naturally this circuit could also be adapted for many other projects – e.g. a bicycle safety light which flashes high intensity LEDs on and off in patterns.

Figure 3 shows the circuit diagram for the system. I/O pin 4 is configured as an input and has a switch connected. The other pins are used as outputs and are connected to the LEDs which are laid out in the dot pattern of a traditional dice. Note that the diagonal pairs of LEDs are driven from the same I/O pin as they also light at the same time.

Figure 4 contains a program that cycles through the six possible patterns until the switch is pressed. When the switch is pressed the dice stops for a couple of seconds on the current

Fig. 3 Electronic Dice Circuit



```
main:
       high 1                          'show dots for number 1
       low 2
       low 3
       low 0
       if input4 is on then delay      'test switch
       low 1                           'show dots for number 2
       high 3
       if input4 is on then delay      'test switch
       high 1                          'show dots for number 3
       if input4 is on then delay      'test switch
       low 1                           'show dots for number 4
       high 0
       if input4 is on then delay      'test switch
       high 1                          'show dots for number 5
       if input4 is on then delay      'test switch
       low 1                           'show dots for number 6
       high 2
       if input4 is on then delay      'test switch
       goto main                       'loop back to start

delay: wait 3                          'wait 3 seconds
       goto main                       'loop back to start
```

Fig. 4 Electronic Dice Program

pattern. As the numbers cycle so quickly (more than 5000 times a second) it is impossible to anticipate the number! Figure 5 shows the same program drawn as a flowchart.

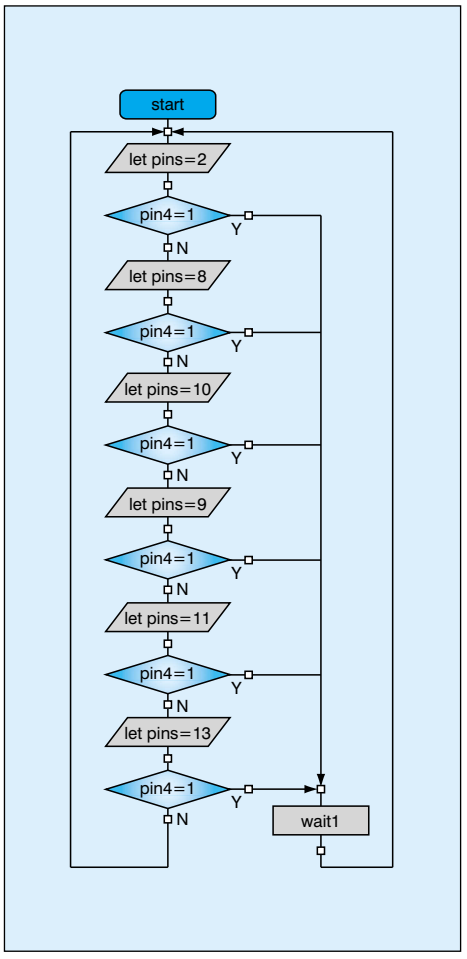


Fig. 5 Electronic Dice Flowchart

Sample Project 2 – Cyber Pet

This project provides more programming and design options for the students as it is much more 'open ended'. The project is based around the Furby™ toy concept - an electronic pet that reacts to external stimulus. In it's simplest form the circuit diagram shown in Figure 6 consists of two LED 'eyes', a piezo sounder (Rapid 35-0200 at 7.5p), a push switch and a LDR light sensor (Rapid 58-0134 at 18p). This can be constructed as a 2-dimensional 'flat' pet.

A modification of the circuit could be to link both the LEDs from the same I/O pin (as in the dice project above) and then the spare output could be used to control one of the new 'movement' modules supplied by Rapid Electronics (Figure 7). These modules are as the type used in novelty 'Singing Santas' and are ideal for this type of project, although in this case they

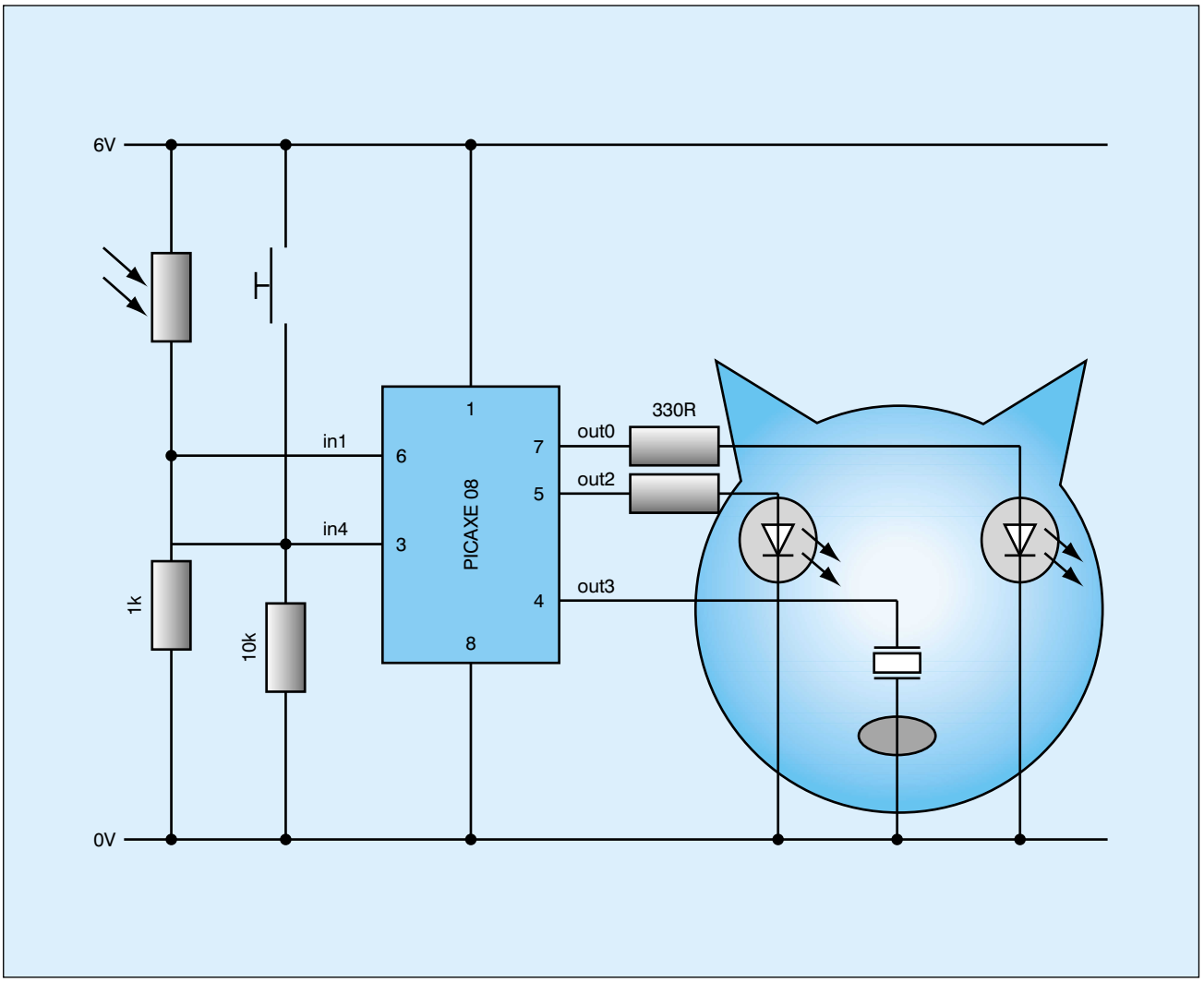


Fig. 6 Cyberpet Circuit

would take the project slightly over the cost of the school lunch! Use of this type of module also provides a very interesting method of combining electronics within textiles projects.

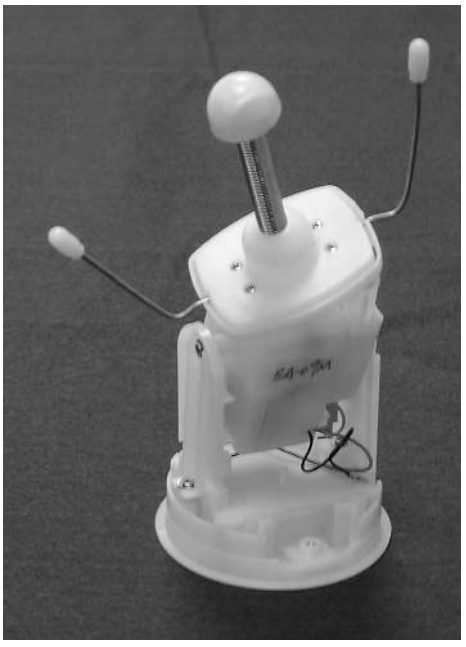


Fig. 7 Rapid Electronic Movement Module

Figure 8 shows a program that flashes the LEDs on and off to indicate some 'life' in the pet. When the switch is pressed a noise is made on the piezo sounder, and when the light sensor is covered the LED flashing stops. Naturally the students can use their imagination to add their own 'personality' to the cyberpet projects.

Summary

Prototypes of the circuits are built on PICAXE proto boards. Naturally if the school has PCB manufacturing facilities students could design their own PCBs. This new 8 pin microcontroller is at such a low cost that it is now realistic for schools to be able to produce microcontroller based projects for less than the cost of a school lunch!

To provide additional support for teachers the UK Offshore Oil Association have sponsored a kit from Revolution

```
main:
       high 0                        'light eyes
       high 2
       if input4 is on then beep     'test switch for press
       readadc 1,b1                  'read light level
       if b1 < 50 then bed           'if dark goto bed
       pause 500                     'wait 0.5 sceond

       low 0                         'switch off eyes eyes
       low 2
       if input4 is on then beep     'test switch for press
       readadc 1,b1                  'read light level
       if b1 < 50 then bed           'if dark goto bed
       pause 500                     'wait 0.5 sceond

       goto main                     'loop back to start

beep:  sound 3,(50,50)               'make beep noise
       goto main                     'loop back to start

bed:   low 0                         'switch eye LEDs off
       low 2
       readadc 1,b1                  'read light level
       if b1 > 50 then main          'if bright go back to start
       goto bed                      'else loop in bed section
```

Fig. 8 Cyberpet program

Education that provides the hardware required to build both a cyberpet and an alarm system using this new 8 pin microcontroller. Also included is a booklet with examples of several other projects. This kit will be available to schools from the NEC show in November, but can also be pre-ordered for delivery in November by completing the coupon below.

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