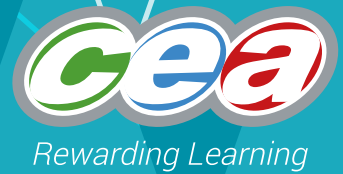# FACTFILE:
GCSE
Technology and Design

OPTION A:
ELECTRONIC AND MICROELECTRONIC CONTROL SYSTEMS
Unit 2.18 Microcontrollers (PICs) – PICs in Robotic Control

2.18 Microcontrollers (PICs) – PICs in Robotic Control

Learning Outcomes

You should be able to:

• discuss the use of PICs in robotic control.

Course Content

One definition of a robot is: A machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer.

Robotics could be considered to be the branch of technology that deals with the design, construction, operation, and application of robots.

Fact File 2.19 will consider robotics in general. Here we will consider how and why microcontrollers (PICs) are used in robotic control.

A typical PIC might have the following connections (Information on specific microcontrollers is not required – DO NOT LEARN CONNECTIONS):
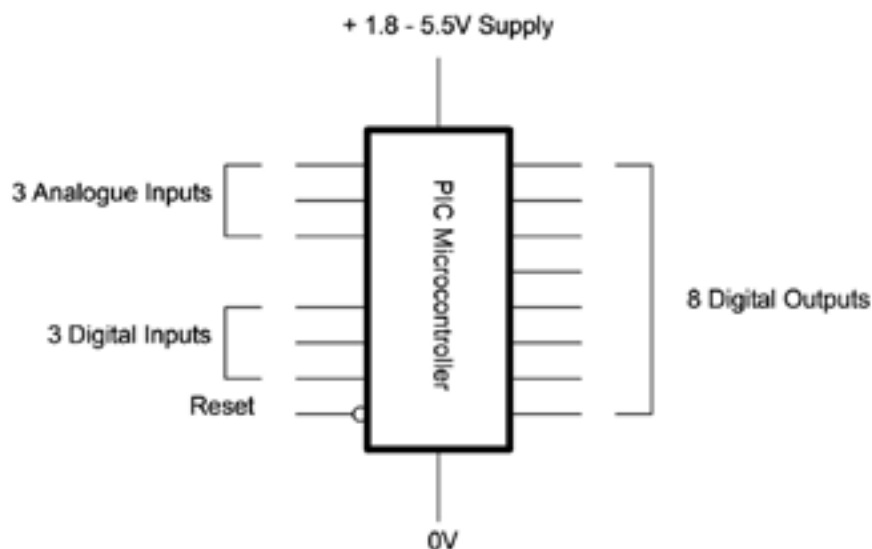
Power:

PICs operate from a low voltage, typically 5.0V although some will operate with as low a supply as 1.5V. This means that a mains supply is not required but typically two or three 1.5V AA cells will be sufficient. In addition, the current drawn by the PIC itself when no outputs are switched on is very low and it is possible to put the PIC into sleep mode to further preserve battery power. As a result of the power requirements of a PIC, it is very suitable for portable applications.

Inputs:

There is a wide range of input devices which permit a robot to gather information about its surroundings. Digital devices such as micro-switches can act to alert a mobile robot of a collision.
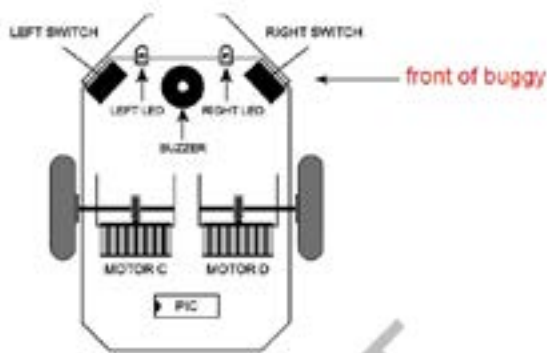
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Line- following robots may use simple LDRs or reflective optical sensors to locate the edge of the line that they are following. These are analogue devices so the analogue-to-digital converters connected to the analogue inputs in the PIC permit the PIC to read the value of the light level.

Digital camera modules are now quite inexpensive and may be connected to a PIC-based system.

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Robotic devices such as robot vacuum cleaners would require cliff and collision detectors in order to avoid obstacles in their path.

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Inexpensive range detectors with a range from 4 cm to 4m are now available and are easily interfaced to a PIC.

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Many other sensors such as accelerometers, compasses and gyroscopes are available and are easily interfaced to a suitable PIC using the digital and analogue inputs provided. Educational PICs have built-in flow chart cells to make inclusion of many sensors into flow charts a simple matter.

Outputs:

The typical PIC pinout shown has 8 digital outputs which it may use to control a wide variety of output devices. Typical output devices could be classified as audio, visual and electromechanical.

Audio: Buzzer (also Piezo Transducer, Loudspeaker – not on this specification).

Visual: Bulb, LED, 7 Segment Display (also LCD Display – not on this specification).

Electromechanical: DC Motor, Solenoid (also Stepper Motor, Servo Motor – not on this specification).

Robots usually involve movement and so electromechanical output devices are of particular importance. Since these usually require large currents, an amplification device such as a transistor is necessary to control these.

Process:

The most import feature of a microcontroller or PIC is that in addition to input/output circuitry it contains memory and processing units. This means that the function of the robot or other device that contains the PIC can be modified very easily. The presence of memory permits robots to remember routes taken or actions performed and also to "learn" to perform tasks.

Hobby Robotics

In recent years, a wide range of low-cost microcontroller-based boards have been produced to encourage interest in the writing of computer code for primary and post-primary pupils and the hobbyist. These include Arduino and BBC micro:bit. These are widely used in making simple educational robots.

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https://www.microbit.co.uk/device
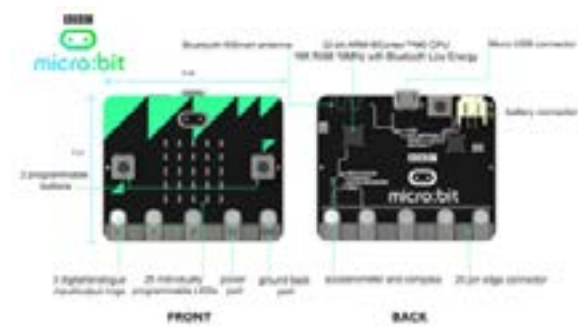
Incredibly, the BBC micro:bit not only has 2 input switches, 3 digital/analogue inputs/outputs, 25 individual programmable LEDs, an accelerometer & compass but has Bluetooth communication to permit it to, for instance, control a camera on a mobile phone!

REVISION QUESTIONS

1. Robotic arms are widely used in manufacturing.

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Discuss why microcontrollers are a good method of control for these machines.

Your answer should focus on **five** points.

Quality of written communication will be assessed in this question.

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