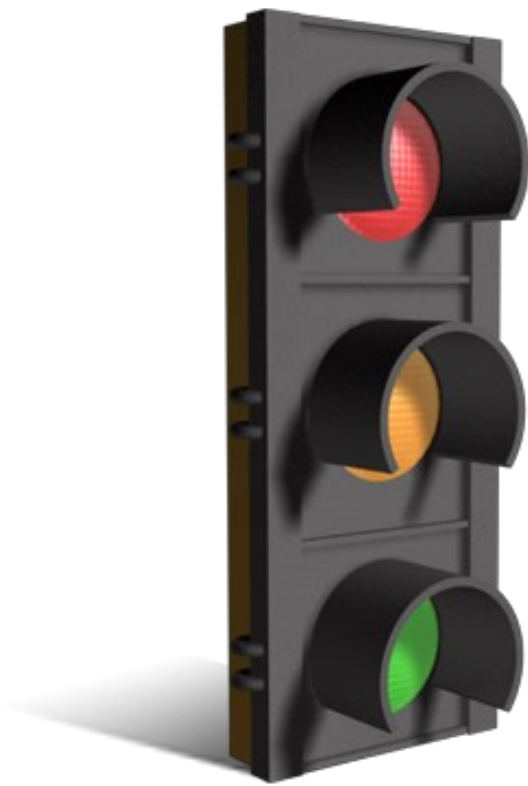


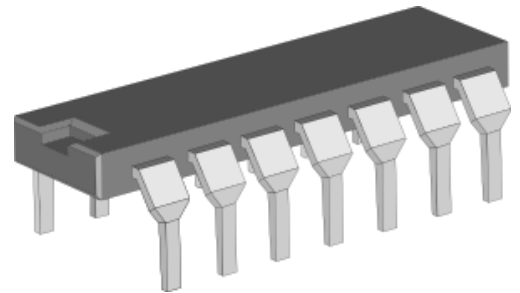
# Take Control



# 'Take Control'

## What is a microcontroller?

A microcontroller is often described as a 'computer-on-a-chip'. It can be used as an 'electronic brain' to control a product, toy or machine.



The microcontroller is an integrated circuit ("chip") that contains memory (to store the program), a processor (to process and carry out the program) and input/ output pins (to connect switches, sensors and output devices like motors).

## Example uses of a microcontroller.

Almost all modern buildings are fitted with some type of alarm. For instance, a fire detection system may have a number of smoke sensors to detect the smoke from a fire.



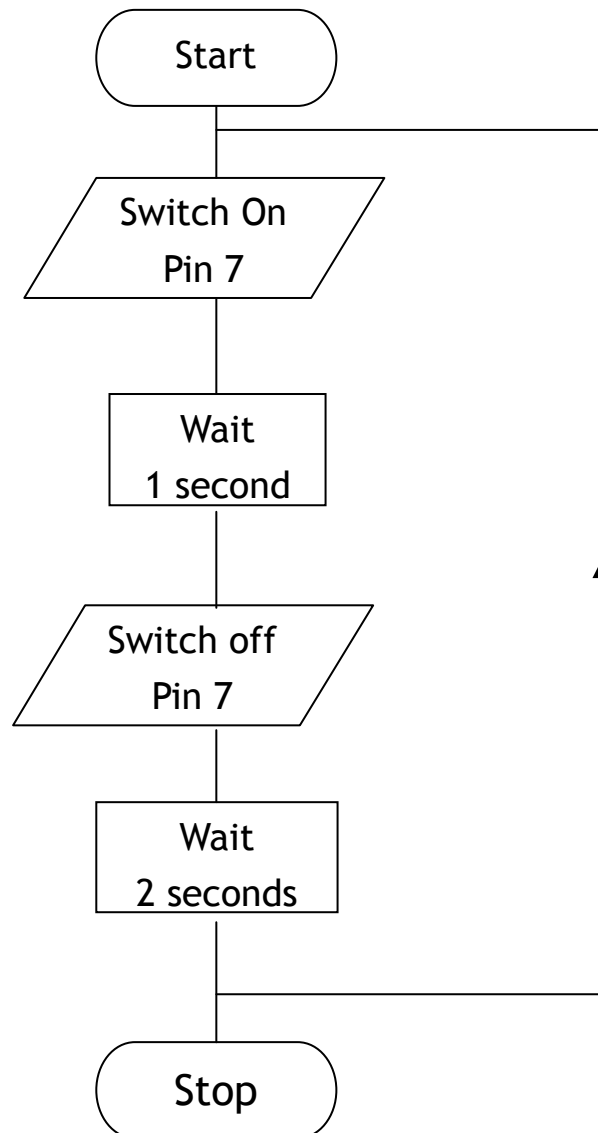
All systems are made up of input and output devices. Often these devices are connected to a microcontroller that interprets the information from the sensors and switches the outputs on and off at the correct time.

In the case of a fire alarm system the inputs may be smoke sensors and the keypad on the front of the control panel. The output devices are the display on the control panel as well as the external siren and strobe light. The microcontroller is the 'brain' of the system.

Microcontrollers are powerful electronic components that have a memory and can be programmed to switch things on and off in a special sequence. The microcontroller in the fire alarm, for instance, has been programmed to switch the siren on and off when the smoke sensor has detected fire.

# Flowcharts

Software engineers like to draw a flowchart for each program that they develop. This makes the overall shape of the program easier to understand.



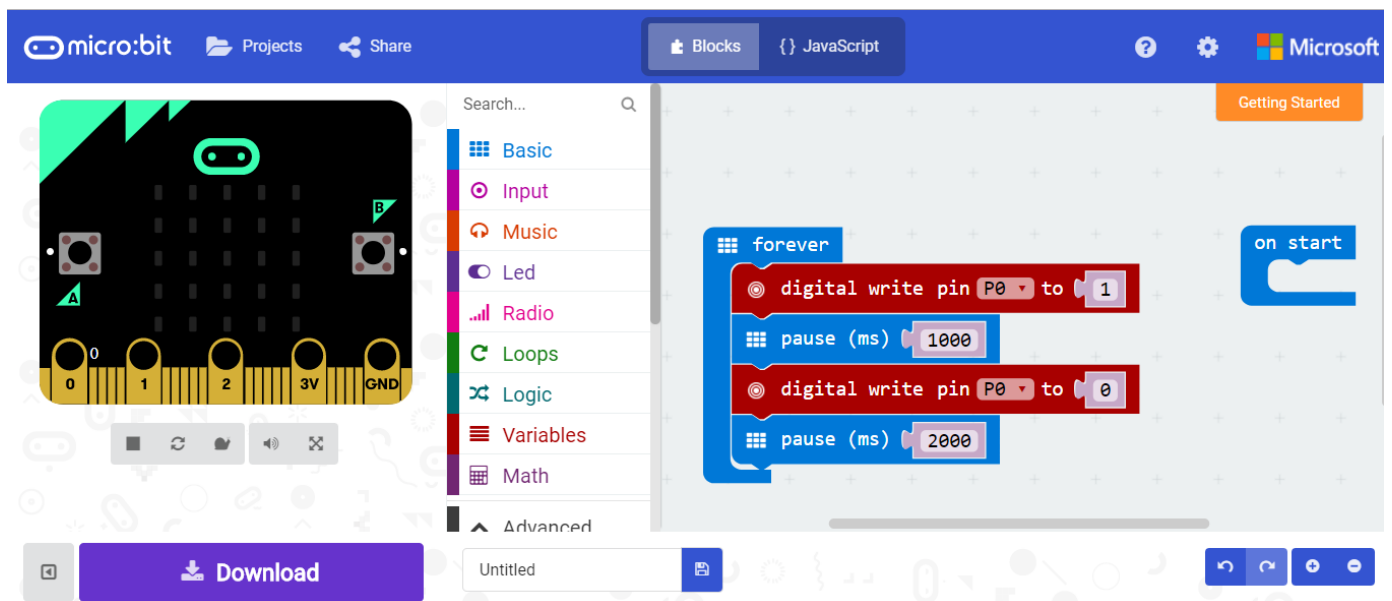
This example of a flowchart uses three different **Symbols** and a **Feedback Loop**.

## Task 1

We are going to use block editor to programme our microbit to switch on and off one output.

Google “makecode.microbit.org” and it will open up block editor.

Complete the following programme.



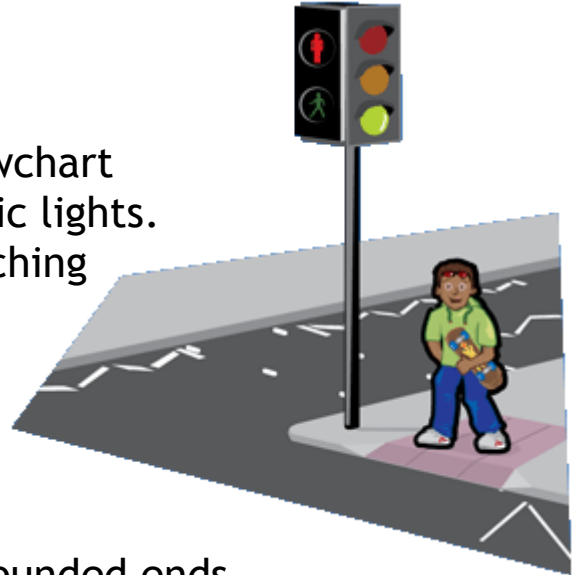
To switch on and off outputs you use the “Digital Write Pins” block, found under the “Pins” heading. A pin is off when set to 0 and on when set to 1.

To make something happen for a set time, the “Pause” block is used, this is found in the “Basic” heading. Microcontrollers work very quickly and the time is in milliseconds (ms) so if you want something to take 1 second you need to type 1000.

The simulator of the micro bit on the left of the screen allows you to check your programme.

## Task 2

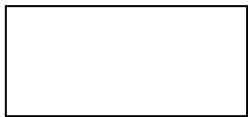
Using the appropriate symbols, draw a flowchart to represent the sequence of a set of traffic lights. Remember to switch off lights before switching other ones on.



### Start / Stop Symbol

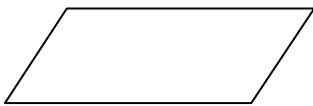
This is a rectangle with rounded ends.

Each flowchart must contain only one 'Start' and end with the 'Stop' symbol.



### Process Symbol

This is a rectangle. The text inside the rectangle should explain what is happening in the program.



### Input / Output Symbol

Anything that is input or output from the microcontroller is shown as text in the parallelogram.

## Task 3

Using your flowchart from Task 2, complete a block editor programme to make the traffic light sequence.

Pin 0	Red traffic light
Pin 1	Amber traffic light
Pin 2	Green traffic light

## Task 4

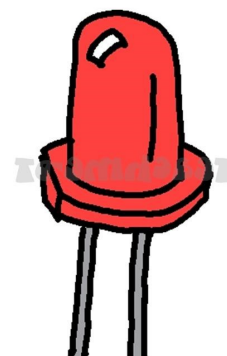
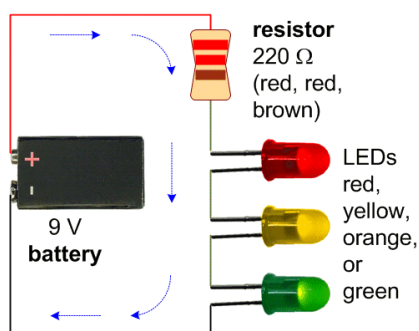
Read the following passage and answer the questions.

### Light Emitting Diode

A light emitting diode (LED) is an electronic component that gives out light when current passes through it. An LED is a special type of diode. A diode is a component that only allows current to flow in one direction. Therefore when using a diode, it must always be connected the correct way around.

LEDs are mainly used as indicator lights. Red and green LEDs are commonly used on electronic appliances like televisions to show if they are switched on or in 'standby' mode. LEDs are available in many different colours, including red, yellow, green and blue.

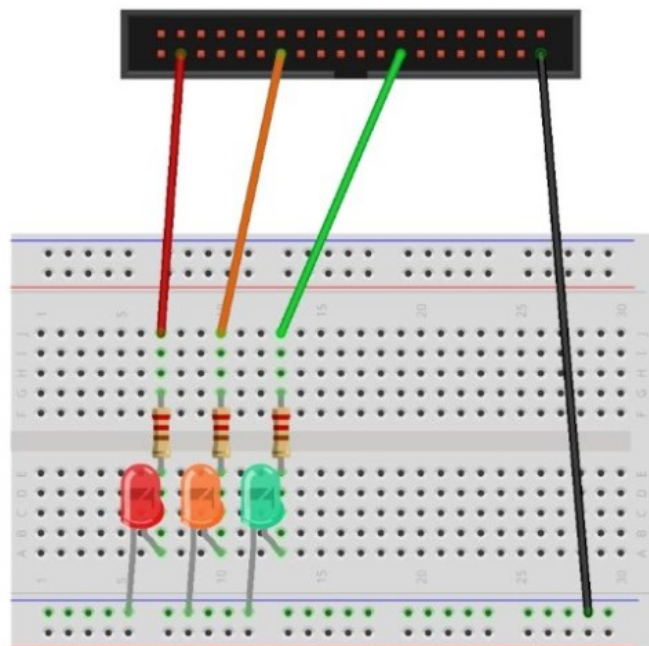
LEDs only require a small amount of current to work, which makes them much more efficient than bulbs (this means, the LEDs will light for a much longer time than a bulb would). If too much current is passed through an LED it will be damaged, and so LEDs are normally used together with a 'series' resistor that protects the LED from too much current.



1. What do the letters LED stand for?
2. What does a diode do?
3. What advantage is there to use LED's rather than ordinary bulbs?
4. What would happen if too much current was passed through a LED and how would you prevent this from happening?
5. Name three devices in your home that use LED's?

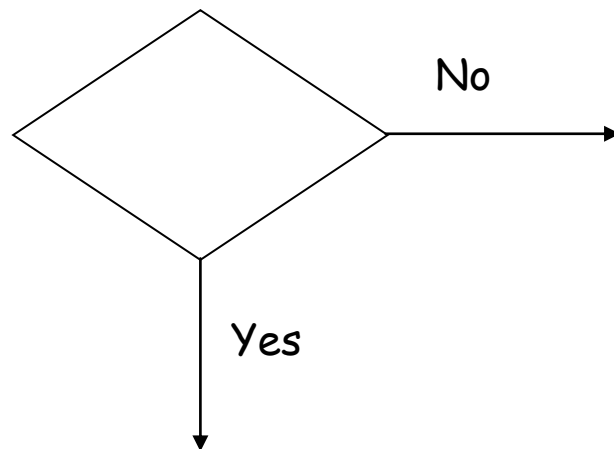
### Task 5

Once you are happy that your programme works, connect up the prototype board with LEDs and resistors to fully simulate the traffic light sequence.



## Making Decisions (Asking Questions)

When making a decision or asking a question, there are often just two possible answers. The answer can be YES or NO, in electronic terms this would be HIGH or LOW.



The **Decision Symbol** for a question is a diamond shaped box with the 'yes' and 'no' arrow showing the direction.

### Task 6

Using the appropriate symbols, draw a flowchart to represent the sequence of a set of traffic lights at a pedestrian crossing. Remember to switch off lights before switching other ones on.

### Task 7

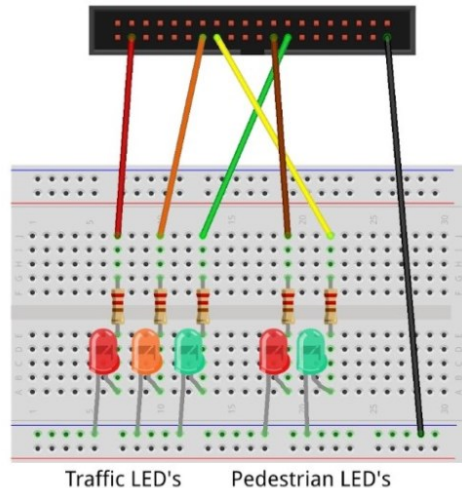
Using your flowchart from Task 6, complete a block editor programme to make the traffic light sequence for the pedestrian crossing.

Pin 0	Red traffic light
Pin 1	Amber traffic light
Pin 2	Green traffic light
Pin 8	Red man
Pin 12	Green man
Button A	Push button



## Task 8

Once you are happy that your programme works, connect up the prototype board with LEDs and resistors to fully simulate the traffic light sequence for the pedestrian crossing.

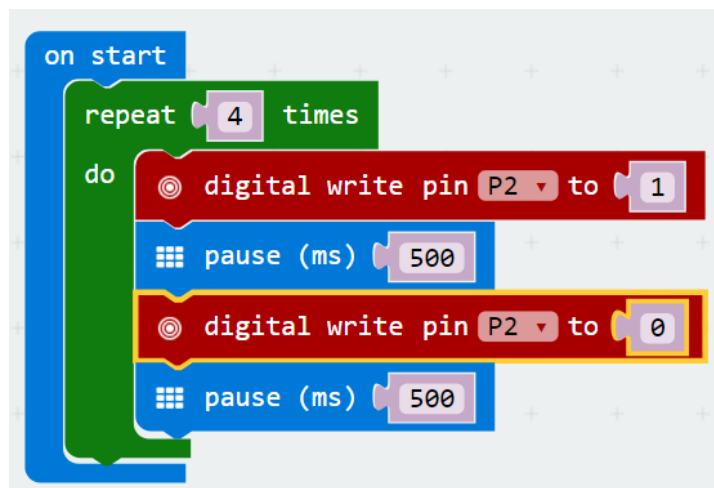


There is a set amount of time that you are given to cross the road. Towards the end of the time limit the green man starts to flash in order to warn you not to start crossing the road and to get a move on.

To make this happen we use the following:

The “repeat” command is found in the “Loops” heading.

The pause is kept very short to make the light flash quicker.



## Task 9

Use the above information to make your green man flash 5 times in your pedestrian crossing program.

## **Task 10**

Finally, there is usually a buzzer that sounds when the green man flashes. We will add in a buzzer to Pin 16 that will only sound at the same time the green man flashes. Create a programme to make this work then test it using the prototype board and components.

## **Extension work**