### The Internet of Things, Families and the BBC micro:bit

Back in the 1980s the BBC ran an educational initiative for homes and families to understand the importance of the emerging technology of microelectronics – the **chip**. It aimed to help us all understand the huge role the chip would have in far reaching developments which affect us all. As part of the programme they produced a computer called the BBC micro so that a new generation could learn how to program. At over £300 this was quite an expensive investment. Soon afterwards there was a Government initiative to pay 50% of the cost of a single BBC computer for every school. Many of the people behind the rise of the UK computer industry and its applications cut their teeth programming the BBC micro as youngsters.
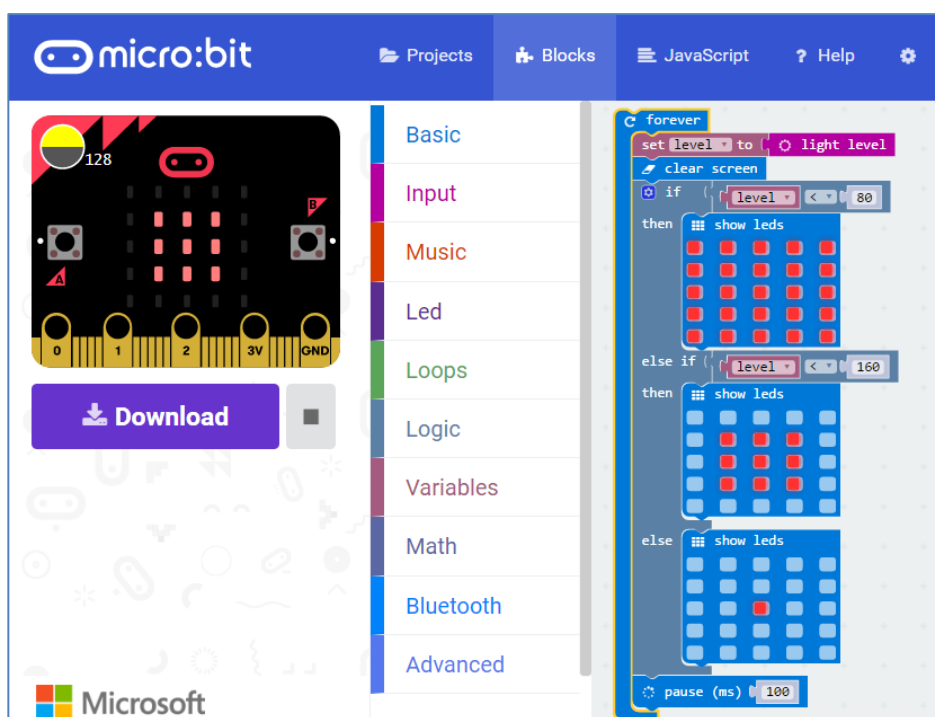
Now we take for granted all sorts of `smart devices', such as mobile phones, smart TVs, car management systems, body scanners, digital cameras and SatNav. Many of these devices rely on having an Internet connection – which is often the cause of much swearing when they fail! Collectively they are all part of what is now called the `Internet of Things' (IoT). In this current highly digital era, the BBC decided to launch a new Digital Literacy campaign aimed principally at homes and families. To accompany this they designed a small, cheap and easy-to-use device called the `BBC micro:bit'. Working with industry and academic partners, it was launched in 2015, and by the summer of 2016 one million had been sent to schools for use by 11-year old students. Shortly afterwards the devices became generally available for purchase. The basic kit is called the `**BBC micro:bit go**', which includes a battery pack and USB cable, and costs c£15. The hardware layout is shown below.
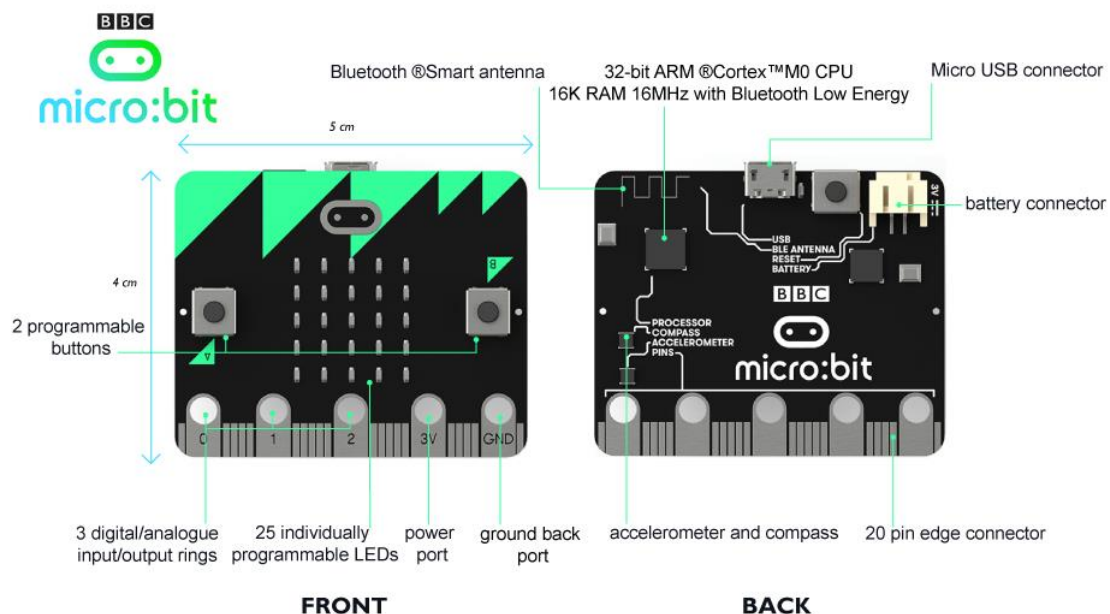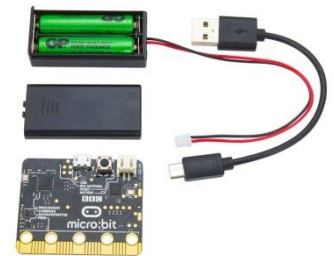
There are many introductory videos to explain how to get going. You can write your own programs for it in a variety of programming languages each with a helpful editor. A very quick way to get started, for which you don't even need your own micro:bit device, is with the Microsoft Programming Experience Toolkit PXT. Part of this is a `block editor' specifically designed for the micro:bit.

Here is a simple program to simulate how a car uses its light sensors to automatically switch on the lights. Each of the coloured words in the middle column opens a menu of blocks. The `forever` loop block is in blue because it came from the blue `Basic` menu. The `set level to` command came from the brown `Variables` menu. The purple `light level` came from the `Input` menu. The `clear screen` command came from the `Basic` menu. The `If` structure came from the grey-blue `Logic` menu, as did the `test` statements such as `level < 80`. The `show leds` commands come from the `Basic` menu, as does the `pause (ms)` command. When you have entered your program in the Blocks mode, it will run in the emulator on the right. This shows that with a light level of 128, the pattern of 9 leds is shown. Of course the emulator can't respond to actual changes in light! In the Projects mode you can give your project a name, such as "*Light sensor*". In order to send the program to the micro:bit you attach it to the computer with the USB cable. When you press `Download` it saves your program, converted into a `hex` file, in your "*Downloads*" folder as "*microbit-Light-sensor.hex*". When you plug the micro:bit into the USB port, the computer recognises it as an external memory drive, maybe as `D:`, so if you right-click on the hex file you can select to `Send to D:`. This starts the download and the led on the back of the micro:bit flashes. Once it has transferred, the program starts to run, and you can shine a torch over or near or away from the micro:bit to check your program works OK. When you disconnect the USB cable the micro:bit goes to sleep until you connect a battery box, which will cause the program to resume. At £15 every member of the family could have their own micro:bit – maybe in their Christmas stocking! For enhanced fun you might like add some extra devices to the family micro:bit club. Here are some recommendations:

- Kitronik Inventors' Kit: c£25, enables you plug a micro:bit into a `bread-board` to carry out electronics experiments using leds, resistors, switches, motors etc. It contains a book with 10 experiments
- Kitronik buggy: c£26, gives you the components to build your own line-following buggy onto which you just plug in your micro:bit.
- Kitronik M1: power board: c£5, provides a hard protective case, a buzzer, and a coin cell battery which makes it easier to use the micro:bit a bit more robustly.
- Kitronik Audio cable: c£2.65 uses crocodile clips to connect the micro:bit to a mono adaptor for headphones or external speakers.

For a very friendly user guide to the BBC micro:bit for the Internet of Things see the site developed by Graham Hastings of St. John's College School, Cambridge. There are free programming Apps for Apple devices here, and for Android here. For free Apps for mobile devices see the Bitty Software site. Further ideas can be found on the BBC, IET, Micro:bit, Samsung, STEM Learning and TES sites. Have fun!