Supporting the DT Curriculum Tutorial

Overview

This Tutorial simulates the starting of a car engine when the petrol tank is 75% full using one Kookaberry. You will then connect it to another Kookaberry and show how the engine can only be started when the tank is both 75% full AND an ignition button is pressed.

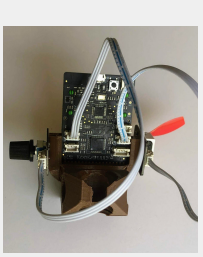
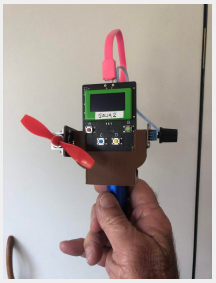
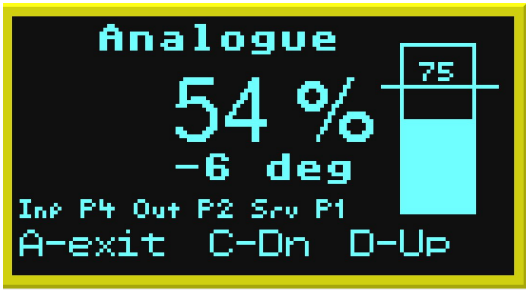
This simple and fun example illustrates how using the Kookaberry in your lesson plans supports many DT content descriptions and outcomes including

- ST3-11DI-T: Explains how digital systems represent data, connect together to form networks and transmit data
- ACTDIK014 : Examine the main components of common digital systems and how they may connect together to form networks to transmit data
- ACTDIP016: Acquire, store and validate different types of data, and use a range of software to interpret and visualise data to create information.

You will be using the Analogue and Logic apps. The Analogue app displays a varying level of voltage from an analogue input and triggers a control signal at an adjustable threshold.

The Logic app illustrates the operation of the various Boolean algebra logic gates used to perform mathematical calculations in a computer. We will be using the AND and OR gates (the first two) for this tutorial.

Introducing the motor and the petrol tank

Step	Description	Resource
1	Attach a fan module to one side of a Kookaberry handle using the small screws in your kit, and a potentiometer to the other. Connect the fan to P2 and the potentiometer to P4	 
2	Run the Analogue app and set the threshold to 75% using the C and D buttons. Rotating the potentiometer progressively alters the input voltage at connector P4. When the voltage input is in excess of 75% of its total range (between 0 and 3v), an output signal of 3v is sent to connector P2 .	

Step	Description
3	Turning the potentiometer to vary the voltage applied to P4 simulates filling a petrol tank at a pump; and the 75% threshold the level at which the driver determines when the car is OK to start. This is demonstrated by the fan motor operating automatically when the threshold is reached. However, we don't want the car to start automatically once the petrol tank reaches a certain level – we want control over when it starts. This is where the next stage of this Tutorial kicks in. But first an explanation of the Logic app which we will use to add an ignition switch.

Logic App Basics

The Logic app provides a physical representation of the five Boolean states – AND, OR, NAND, NOR, and XOR. These are commonly referred to as Gates and are fundamental computer mathematical elements. Two inputs (P4 and P5) are showing leading into a gate which, depending upon the logic state and the combination of inputs, will produce an output on P2.

It sounds more complicated than it really is. Far easier to just try out the various modes. This is where the Kookaberry really helps by bringing theory to life.

The Gate logic is as follows. We will use the AND Gate in this Tutorial.

1. **AND Gate**: If both P4 **AND** P5 are ON = P2 is ON. If one input is ON and the other OFF, P2 is OFF
2. **OR Gate**: If either P4 **OR** P5 are ON= P2 is ON. **ALSO** if both inputs are ON, then P2 is also ON (See also XOR gate). If both inputs are OFF, P2 is OFF
3. **NAND (Not AND) Gate**: If both P4 **AND** P5 are OFF = P2 is ON. If one input is OFF and other ON, P2 is ON
4. **NOR Gate (Not OR):** If either P4 **OR** P5 is OFF= P2 is ON. If either, or both, inputs are ON, P2 is OFF
5. **XOR (Exclusive OR)**: This is the same as the OR Gate except that if both inputs are ON, P2 remains OFF.

Inputs P4 and P5 can be turned ON by pressing Buttons C or D respectively .

What is happening within the Kookaberry?

The Logic programme continuously checks for the presence or absence (also known as the "state") of an input signal at P4 and P5. If it detects 3 volts, it determines that the connection is in an ON state and shows a "1" against the appropriate connector on the screen. If there is no signal, it assumes the connection is OFF and shows a "0".

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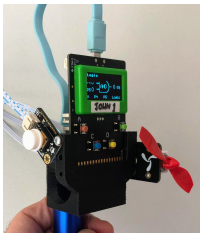
The introduction of logic gates in primary school years may appear premature, but they are interesting and have been shown to be easily understood when presented in this practical context.

Adding a starter button

Step	Description	Resource
1	Unscrew the **fan module** from the side of the first Kookaberry and attach it to the side of a second one. Connect it to P2. Leave the **potentiometer** attached to P4 on the first one. Attach a **push-button** to the handle of the second Kookaberry and connect it to P5. *This will represent the ignition switch of the car.*	
2	Run the **Logic** app. The screen will show an **AND** gate. Both the inputs (P4 & P5), and the output (P2), of the logic gate will show ñ0ò which is the OFF state. Operate the push-button. This turns P5 ON but P2 remains OFF. ***Why is P2 still OFF?(Check the Logic basics for answer)***	 

Bringing the Kookaberries together as a digital system

Step	Description	Resource
1	Join the two Kookaberries together with a three-core jst/jst lead between P2 on the first Kookaberry and P4 on the second. An **output** signal at P2 of the first Kookaberry will now be presented as an **input** signal at P4 of the second.