Soil Defenders - Session 5

How can automation make fertilising fields more efficient?

Context:
Learners think about how technology can improve new innovations in arable farming. After harvesting, the soil is depleted of nutrients, and farmers use slurry to add nutrients back into the soil, ready for new crops. Learners create a program on the micro:bit which simulates turning the slurry spray on and off so that waterways or neighbouring properties are protected from excess slurry going over the field boundaries.

Engineering focus:
Learners will be working as an engineer by improving design ideas. They will take the thoughts and ideas in their heads and put it into drawings or words so someone else can respond to it.

Learning time:
2 hours

Suggested age group:
7-9 years old

Keywords
automation
efficiency
fertiliser
nutrients
slurry
Microbit
program
algorithms
debug
sequence
input
output

Curriculum for Excellence links:
First Level:
I explore and discover engineering disciplines and can create solutions. TCH 1-12a
I can demonstrate a range of basic problem solving skills by building simple programs to carry out a given task, using an appropriate language. TCH 1-15a
Second Level:
I can extend my knowledge and understanding of engineering disciplines to create solutions. TCH 2-12a
I can create, develop and evaluate computing solutions in response to a design challenge TCH 2-15a

Resources:
- Challenge Instruction Video
- computer with access to the internet for MakeCode
- micro:bits (or micro:bit simulator at MakeCode)
- servos (optional)

If you don't have micro:bits in your school, you can still complete this lesson using the online micro:bit simulator at https://makecode.microbit.org/

Understanding the problem

Ask learners to talk about and share what might have happened in the photo on slide 2. Explain that the first picture is of a car which was parked too close to a field when a farmer was spraying the field with slurry to fertilise the soil.

1

Explain that farmers spray their fields with fertiliser and their challenge will be to create a technological solution to prevent the spray going beyond their field (slide 3). The task is to engineer a solution to turn off the spray as the tractor turns at the boundary of the field, and then automatically turn it on again. Explain that the micro:bit is a small computer that will simulate whether the tractor is spraying or not (slide 4 & 5).

Code Exploration

Explain to learners that we will be using the micro:bit's buttons to explore how these work with some simple code. Display the code on slide 6 and ask the learners what they think the commands might do when the program is run. Why do they think this?
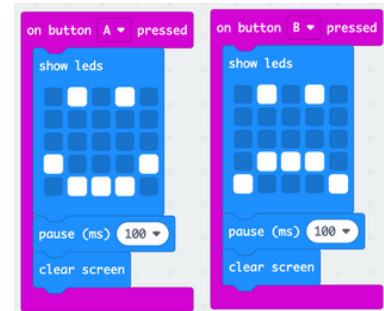
MakeCode commands are quite easy to read as they use clear language terms. When run, this code will display a smiling face on the LEDs when button A is pressed and a sad face when button B is pressed. Both faces will disappear after 100ms and the screen will be clear again. Give learners time to add the above code to their micro:bits. Ask learners to run the code to see if their predictions were correct.

2

Challenge the learners to:
- change what is displayed by clicking on the individual LEDs
- add another 'on button pressed' command and get the micro:bit to display something different when buttons A+B are pressed together
- change the time the LEDs display for before the screen is cleared.

Then lead a class discussion to consolidate key learning about the code, namely:
- When a button is pressed this triggers the LEDs to display the pattern chosen.
- The 'pause' command can be used to change the duration the LEDs display for before the screen is cleared.
- The 'clear screen' command sets all the LEDs to off.

Image Credit: Andy Harris/Graham Horn

Using the Microbit to solve a problem:

3

Remind learners of our problem: *we want to create a technology solution to prevent the manure being sprayed beyond the field when the tractor reaches the boundary.* Explain to learners that the micro:bit's LEDs will be used to simulate whether the tractor is spraying or not. When it is spraying, the LEDs will look as shown below and will be off when it is not spraying (slide 7).
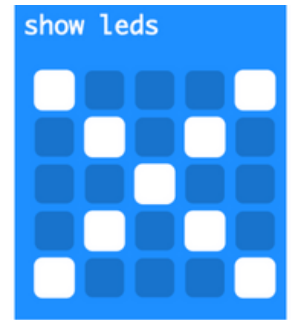
LEDs to show tractor is spraying

Ask learners to consider how we could use what we have just learnt to tackle this challenge. Lead a discussion to arrive at the following ideas:
- the manure spray could be turned off by pressing a button on the Microbit
- the spray could automatically resume after an amount of time using the 'pause' command
- different buttons could pause the spray for longer - if the tractor had to cross a road between fields for example.

Support learners' programming: Parson's Problem

A Parson's problem scaffolds programming tasks by providing learners with all the code they need to complete a problem but doesn't show how the code should be combined (slide 8).

4

Ask learners to add the following commands to their micro:bit project and task them to combine the code to complete our challenge: for instance,
- spraying starts when the program is run.
- spraying is paused for different amounts of time when either the A or B button is pressed and then automatically resumes.
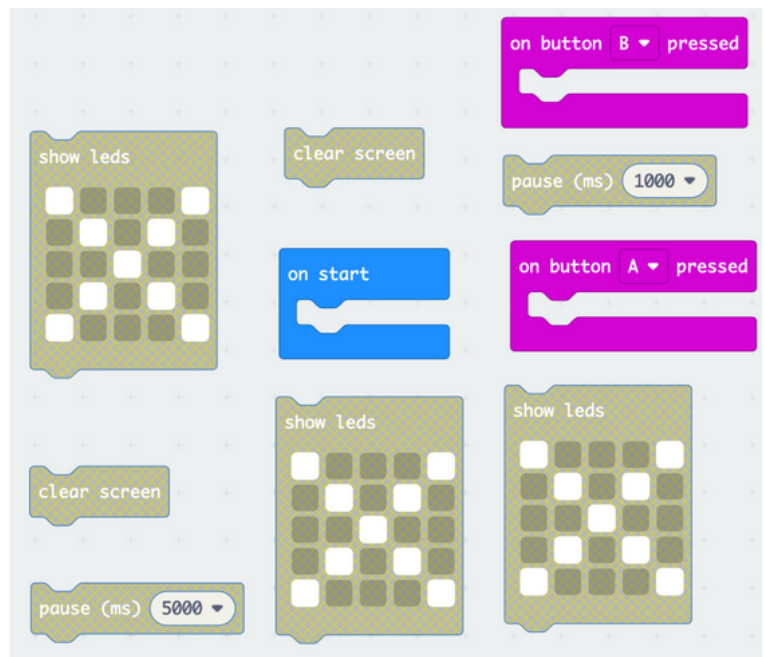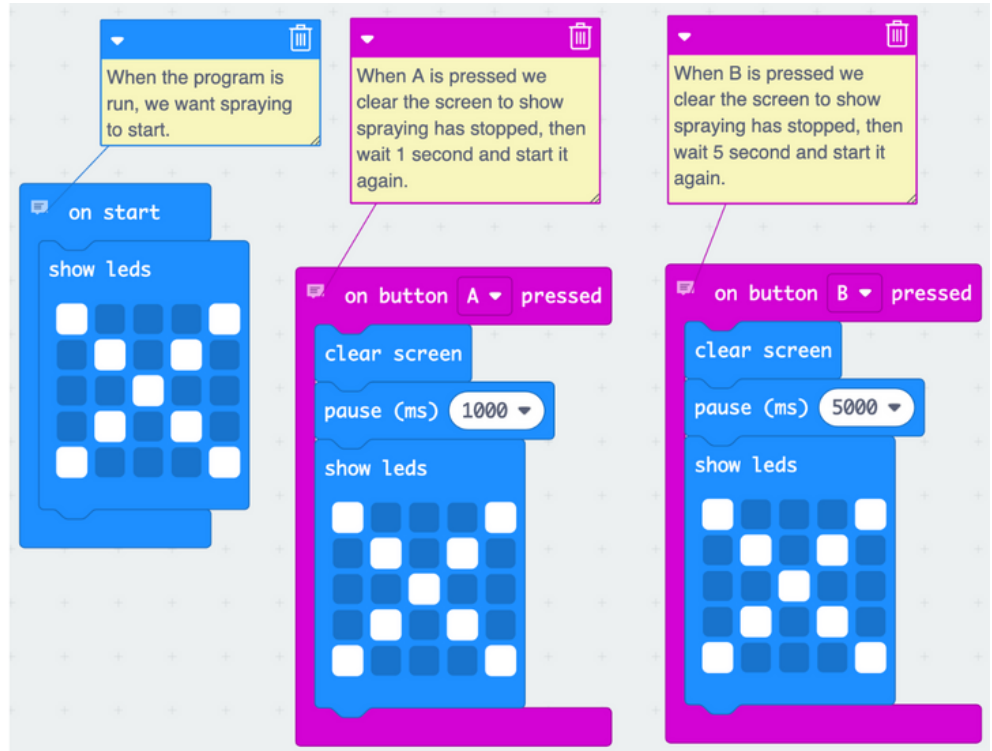
Share the solution to the problem (slide 9)

5

Do learners think the time the spraying is paused for is enough? Can they change their code to increase it?

Allow plenty of time for learners to tinker with their code to improve their solution to the problem.

When the program is run, we want spraying to start.

When A is pressed we clear the screen to show spraying has stopped, then wait 1 second and start it again.

When B is pressed we clear the screen to show spraying has stopped, then wait 5 second and start it again.

Evaluate:

6

Lead a discussion with learners to evaluate the success of their program. Did their program:
- Turn the spray off when the buttons were pressed on the micro:bit (tractor)?
- Turn the spray back on automatically after different lengths of time?

Discuss with learners whether they encountered any bugs in their program - what were these and how did they remove them?

Further links:
- Micro:bit Education Foundation
- Information about the new (2022) micro:bit V2
- Information about micro:bit accelerometer
- Support and guidance on using servos with a micro:bit