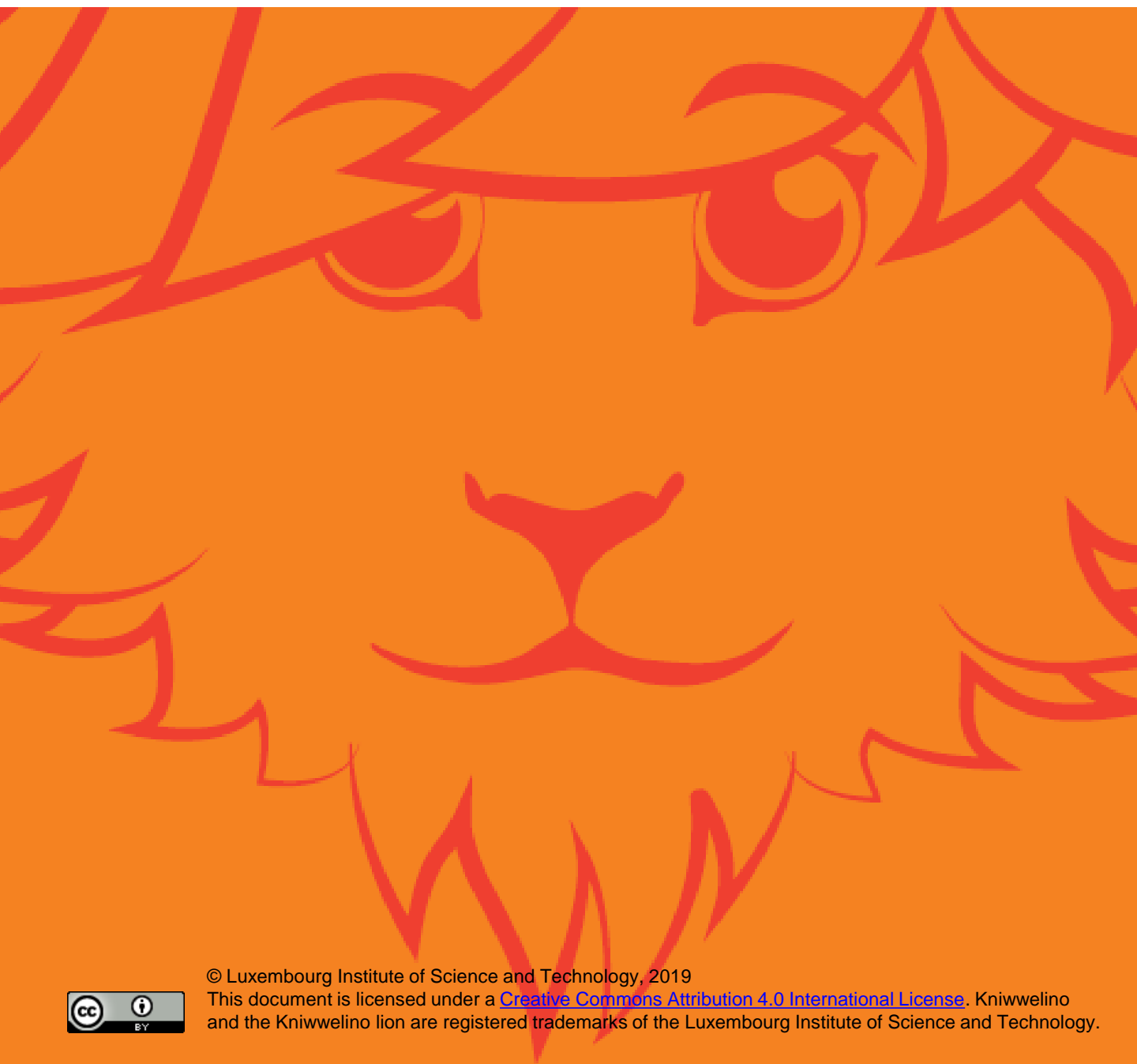




ACTIVITIES



© Luxembourg Institute of Science and Technology, 2019

This document is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/). Kniwwelino and the Kniwwelino lion are registered trademarks of the Luxembourg Institute of Science and Technology.



Activities

Activity sheet

Presentation

How to use the activity sheets?

The Matrix

The coloured LED

Alternating colours

Animation

Buttons and matrix

Messages

Variable

Variables and logic

Time and mathematics

Matrix and loops

External LED

Buzzer

External button

Servo motor SG90

Neopixel LED strip

Temperature sensor DS18B20

Distance sensor HC-SR04

DC motor

Potentiometer

Light sensors

Sound sensor

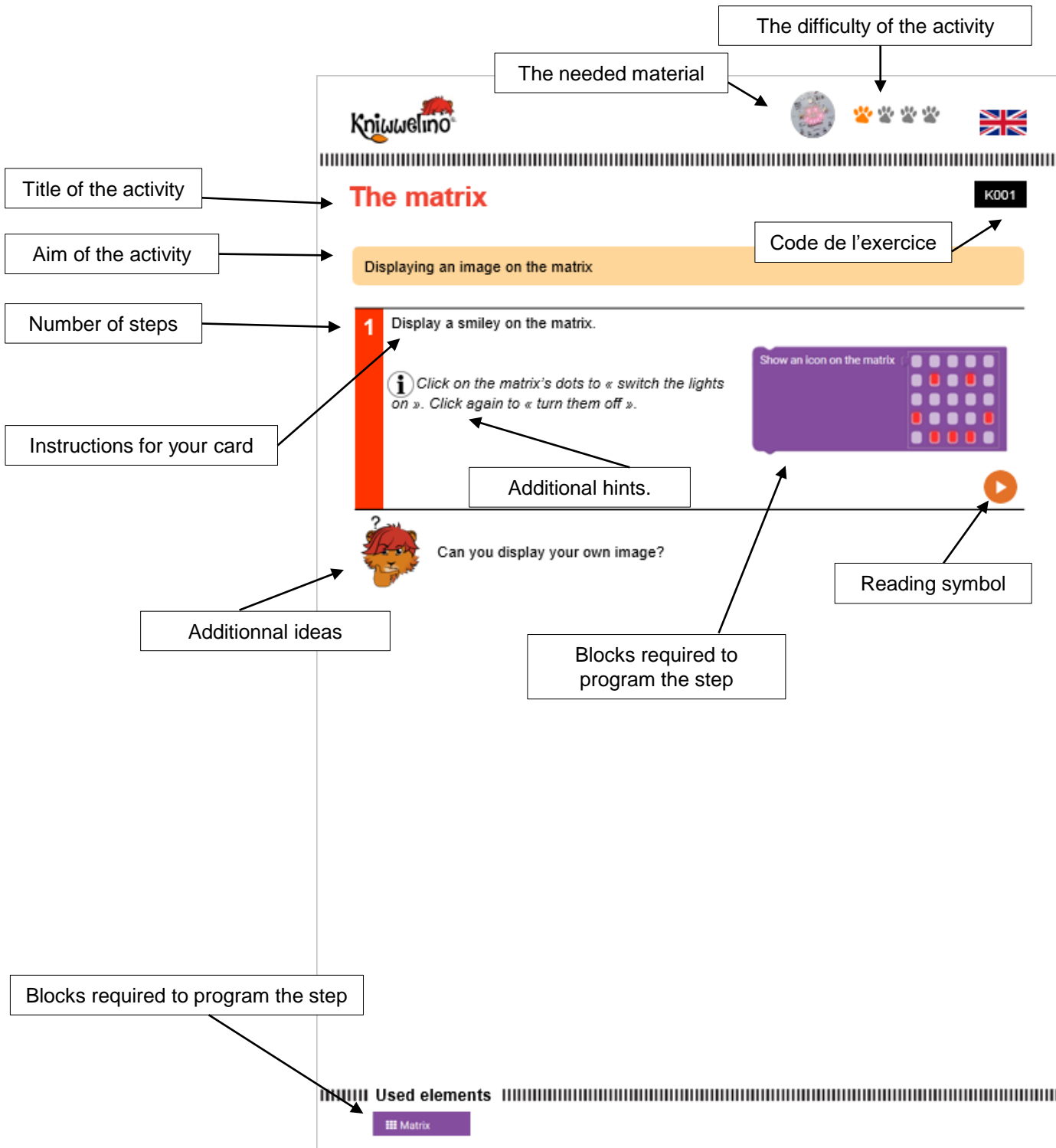
Coloured temperature display

Distance sensor and Neopixel LED Strip

Solutions

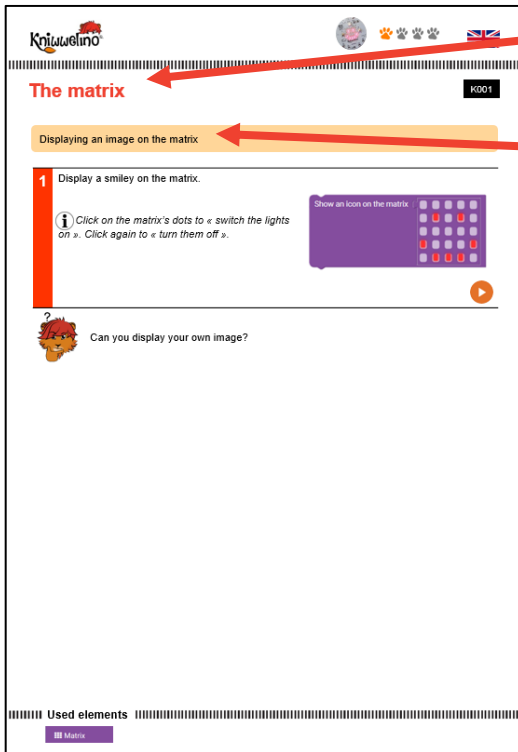
Activity sheet

Presentation



Activity sheet

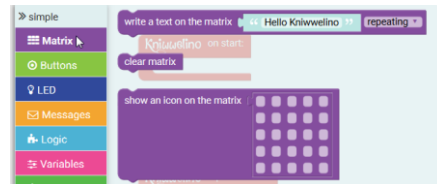
How to use the activity sheets?



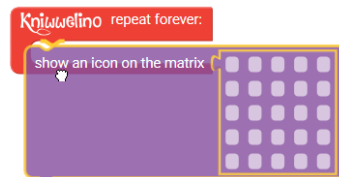
1. Read the **title** and the **aim**. It tells you what this activity is about.

2. Read the instruction of the **first step**.

3. Search and retrieve the required **block(s)** from the menu.



4. **Now it's your turn!** You need to connect the block(s) with the blocks already available in your program. There are several ways how they can be connected, but not all of them are correct. **It's up to you to figure out the correct way of assembling the blocks!**

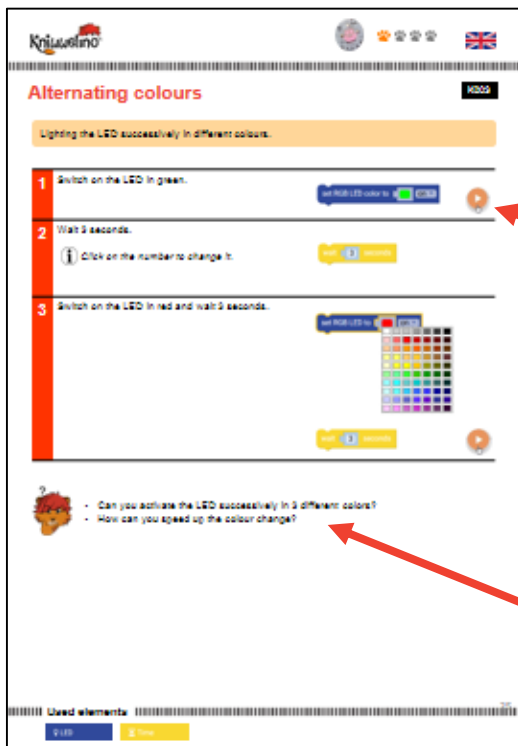


5. In case you see the orange play button: use it to **transfer your program and test it**.

Make sure your program is doing what it is supposed to do. If not, then revise your program.

6. Continue with the next steps: read the instruction and add the next block(s) to your program. Again, test the result if possible.

7. When done with all the steps, you are free to change your program and **try out Lino's suggestions** or even your own ideas!



8. Don't forget to delete the different blocks used before a new activity.

PROGRESS

Activity	Date	Comment
The Matrix		
The coloured LED		
Alternating colours		
Animation		
Buttons and matrix		
Messages		
Variable		
Variables and logic		
Time and mathematics		
Matrix and loops		
External LED		
Buzzer		
External button		
Servo motor SG90		
Neopixel LED strip		
Temperature sensor DS18B20		
Distance sensor HC-SR04		
DC motor		
Potentiometer		
Coloured temperature display		
Distance sensor and Neopixel LED Strip		

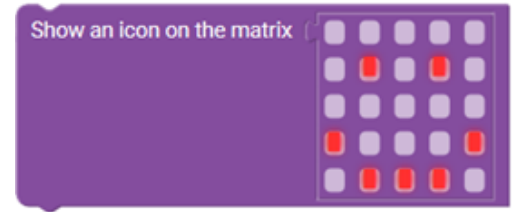
The matrix

K001

Displaying an image on the matrix

1 Display a smiley on the matrix.

i Click on the matrix's dots to « switch the lights on ». Click again to « turn them off ».




Can you display your own image?

The coloured LED

K002

Switching on the LED in a colour, making it blink and changing the brightness

1 Switch on the LED in green.

set RGB LED color to  on



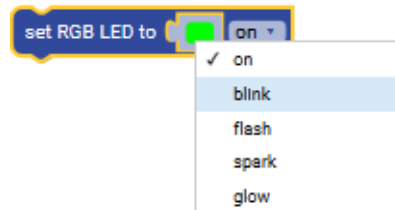
2 Change the color.




i To choose another colour, click on the green field: the palette of available colours is displayed.



3 Make the LED blink by changing the effect.



4 Decrease the brightness of the LED.

set RGB LED brightness to  200




What happens if you choose flash, spark or glow as an effect?

Alternating colours

K003


Lighting the LED successively in different colours.

1 Switch on the LED in green.

set RGB LED color to  on



2 Wait 3 seconds.

 Click on the number to change it.

wait  seconds

3 Switch on the LED in red and wait 3 seconds.

set RGB LED to  on



wait  seconds



Can you activate the LED successively in 3 different colors?

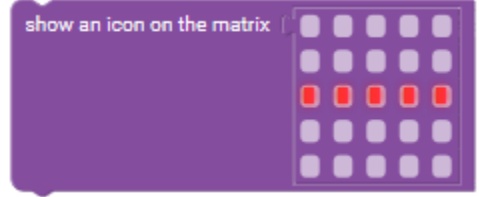
How can you speed up the colour change?

Animation

K004

Creating an animation consisting of multiple images displayed at 1 second intervals.

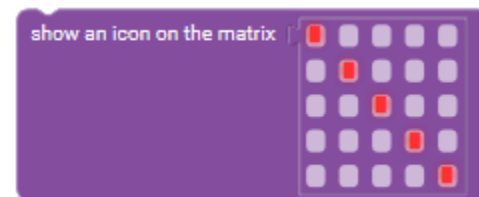
1 Display an horizontal bar on the matrix.



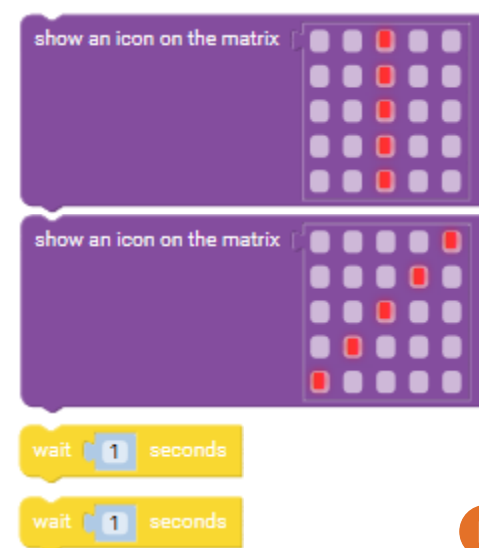
2 Wait 1 second.



3 Display a slash bar on the matrix during 1 second.



4 Continue until you created the complete animation.



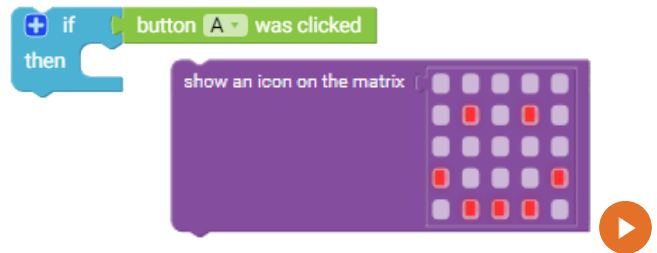
Can you create your own animation?

Buttons and matrix

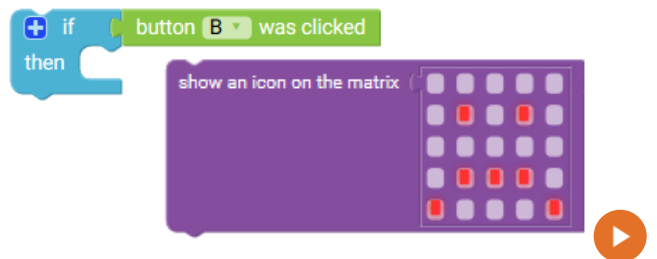
K005

Displaying images on the matrix at the click of a button. A different image appears for each button (A or B), as well as for A and B.

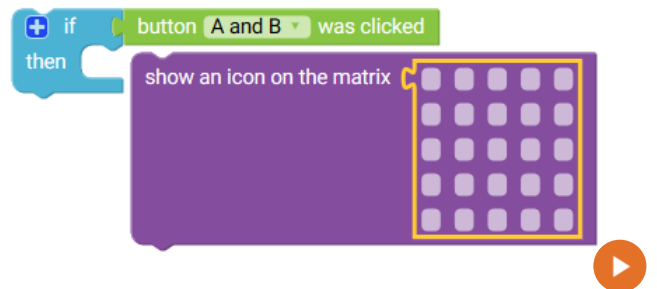
1 When button A is pressed, then display a smile on the matrix.



2 When button B is pressed, then display a sad face.



3 When buttons A and B are both pressed, the display your own image.



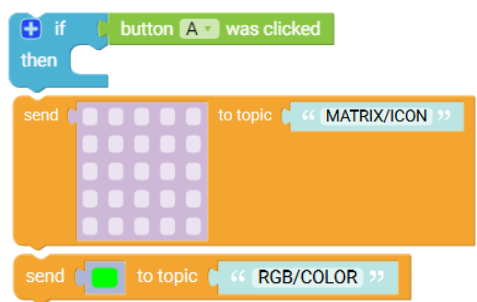
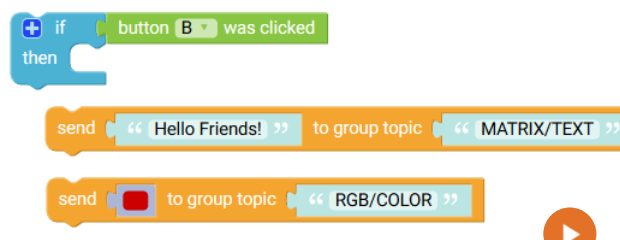
Can you also activate the LED in different colours at the click of the buttons?

Messages

K006

Sending texts, images and colours to another Kniwwelino to change the matrix display or the LED colour.

i Do this activity with a friend so you can send each other messages.

1	Connect the LED and the matrix to predefined topics.	<div>Connect RGB Led to topic RGB/COLOR</div> <div>Connect matrix to topic MATRIX/TEXT and MATRIX/I...</div>
2	Set the group name to something secret. i All Kniwwelinos who are in the same group as you will receive the messages.	<div>create messaging group “ myFriends ”</div>
3	Send a colour and an icon to the predefined topics when button A is clicked.	 <div>▶</div>
4	Send another colour and a text to the predefined topics when button B is clicked.	 <div>▶</div>

Variable

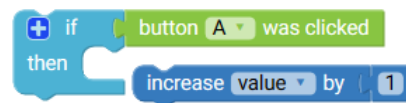
K007

Storing a value with a variable and using it again: each time that button A is pressed, the value of the variable is increased and displayed it on the matrix.

- 1 Set the initial value of the variable to 0 in Kniwwelino on start.



- 2 When button A is clicked, increase the value of the variable by 1.



- 3 Display the value of the variable on the matrix.



What will be the first value displayed?

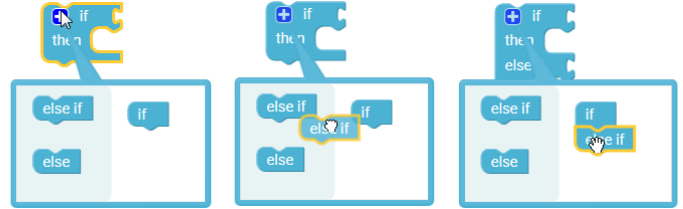
How can you decrease the value of the variable by 1 each time when button B is clicked?

Variables and logic

K008

Selecting and displaying on the matrix an icon from a list of three.

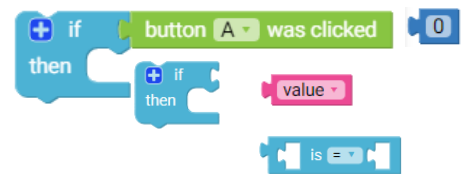
i To add a condition « else if » to a block « if ...then » click on « + » then drag&drop under « if ».



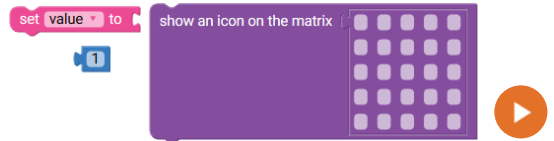
1 Set the initial value of the variable to 0 in Kniwwelino on start.



2 In Kniwwelino repeat forever, if button A is clicked, check if the variable is equal to 0.

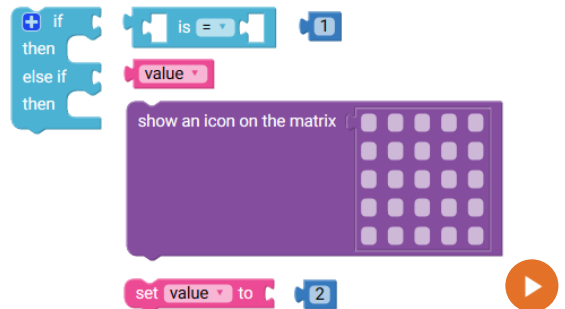


3 If yes, then display a sad face on the matrix and set the variable to 1.



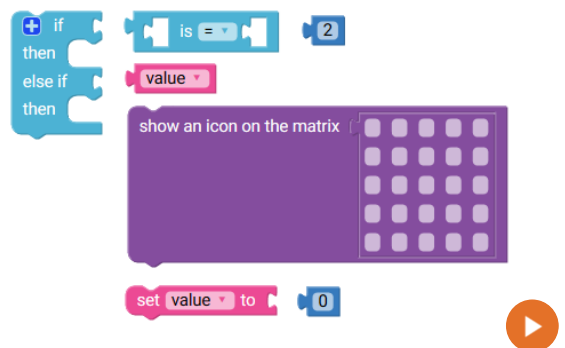
4 Else, check if the variable is equal to 1. In this case display a smiley.

Then set the variable to 2.



5 Else, check if the variable to 2. In this case display your own image example giving a heart.

Then set the variable to 0.

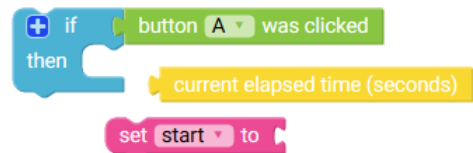


Time and Mathematics

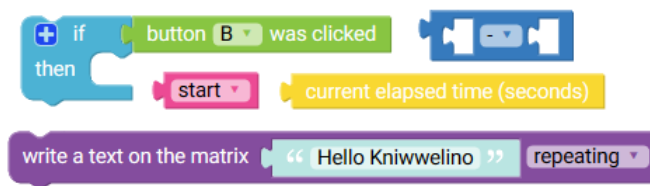
K009

Using time and mathematics to create a simple chronometer. Start the chronometer with button A and stop it with the button B. Display the time on the matrix.

- When button A is clicked, measure the time and set it in a variable called **start**.



- When button B is clicked, then measure again the time and deduct from it the value stored in **start**. Write the result on the matrix.



- Every time I click button A, also erase the matrix.

clear matrix

- When the chronometer is running, switch the LED on in red. If it has been stopped, switch off the LED.

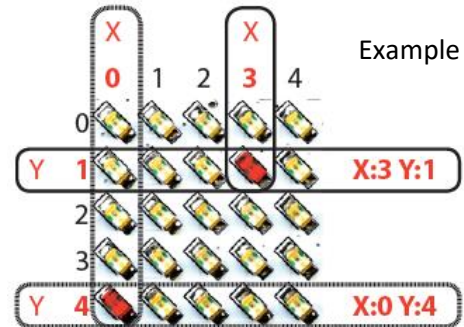
set RGB LED to on
switch RGB LED off

Matrix and Loops

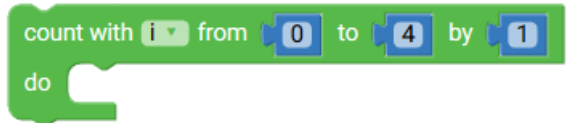
K010

Using loops to repeat something similar: light pixel after pixel on the matrix.

i If you want to draw a single pixel on the matrix, you have to tell Kniwwelino which column (X) and which row (Y) it is in.



1 Create a loop that counts *i* from 0 to 4, increasing each time by 1.



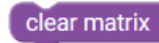
2 Every time you enter the loop, turn on the pixel on column $X = i$ and the row $Y = 0$.



3 Before the end of the loop, wait 1 second.....



4 and erase the matrix.



What do you have to change to turn on the pixels in the middle row?

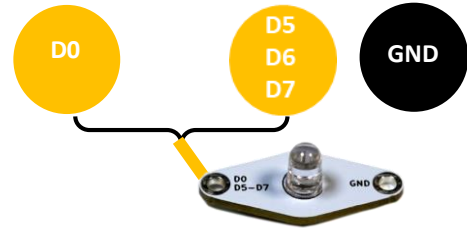
What happens if you delete the matrix only after the loop?

External LED

K011

Switching on an external LED, and making it blink.

1 Connect the external LED via **D0** and **GND**



2 Switch on the external LED.

set external LED on pin **D0** to **on**



3 Make the external LED blink.

set external LED on pin **D0** to **blink**

- on
- ✓ blink
- flash
- off



Can you add a second LED of another color?

Can you switch on the first LED when button A is clicked, and switch on the second LED when button B is clicked.

Buzzer

K012

Connecting a buzzer and playing musical notes.

1 Connect the buzzer via **D5** and **GND**




2 Play the first note: G 4

Play Note  G 4 of duration 1/ 4 on Pin D5



3 Play the second note: C 5

Play Note  C 5 of duration 1/ 4 on Pin D5




4 Continue with the third note: C 3

Play Note  C 3 of duration 1/ 4 on Pin D5



5 Make a pause at the end.

Play Note  Pause of duration 1/ 4 on Pin D5



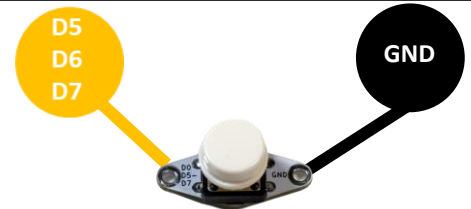
Change the notes and create your own melody!

External button

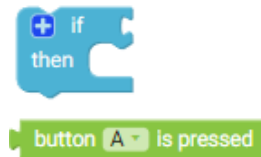
K013

Connecting an external button and using it in the same way as the A&B buttons of the board.

1 Connect the external button via **D5** and **GND**.

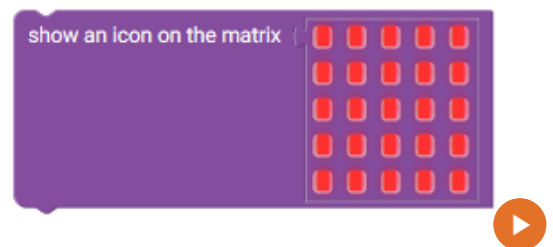


2 Check if the external button connected to D5 is pressed.

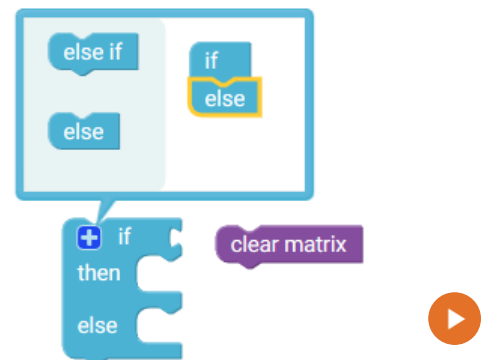


*Be careful to use **is pressed** and not **is clicked**!*

3 If so, turn on all the LEDs in the matrix.



4 Otherwise, turn off the matrix.

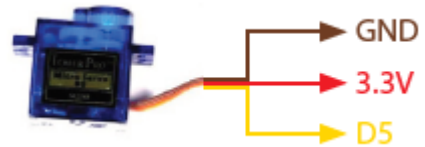


Servo motor SG90

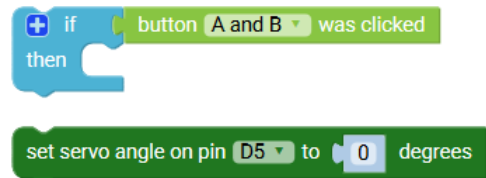
K014

Connecting a servo motor and rotating it when the buttons are clicked.

1 Connect the servo motor via **3.3V**, **GND** and **D5**.



2 If buttons A and B are clicked at the same time then move the motor on the position of 0°.



3 If button A is clicked then move the motor to the 90° position.



4 If button B is clicked then move the motor to the 180° position.

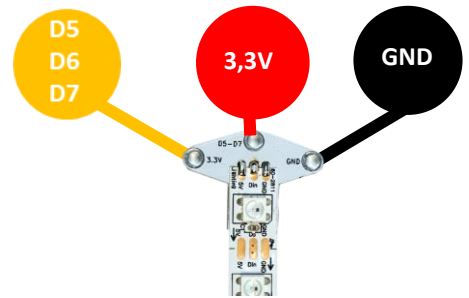


Neopixel LED Strip

K015

Creating an effect on a strip of 5 LEDs.

1 Connect the Neopixel LED Strip via **3.3V**, **D5** and **GND**.



2 Initialize a strip of 5 Neopixel LEDs on the pin D5.

Neopixel LED Strip with size 5 on pin D5

3 Set an effect.

set strip to effect: RUNNING_LIGHTS [18]



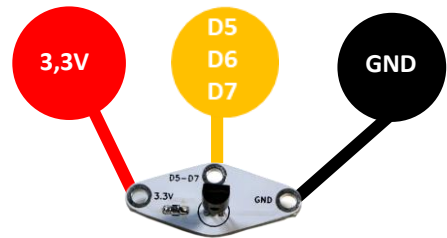
Try other effects! What is your favourite one?

Temperature Sensor DS18B20

K016

Connecting a temperature sensor, reading the temperature and writing it on the matrix.

- 1 Connect the temperature sensor via **3.3V**, **D5** and **GND**.



- 2 Read the temperature and store it into a variable.

set **value** to

DS18B20 read temperature [°C] on Pin **D5**

- 3 Write the temperature on the matrix, and wait until you are finished writing.

value

write a text on the matrix "Hello" once and wait

- repeating
- once
- ✓ once and wait



What is the temperature of the room?

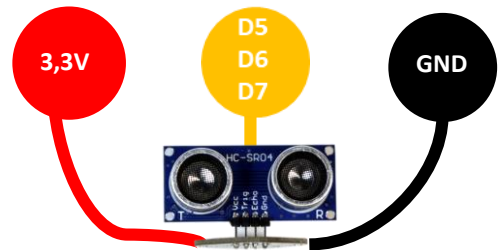
What is the temperature of your finger?

Distance Sensor HC-SR04

K017

Connecting a distance sensor and displaying different colours depending on the distance.

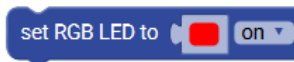
- 1 Connect the distance sensor via **3.3V**, **D5** and **GND**.



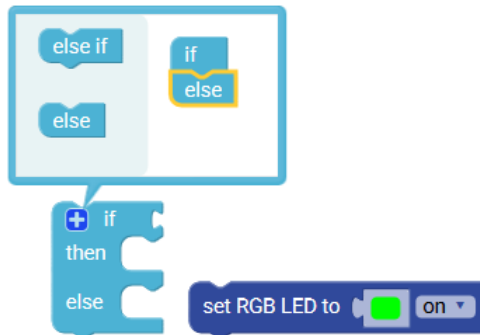
- 2 Detect if a hand is closer than 50 cm.



- 3 If yes, then colour the LED in red.



- 4 If not, then colour the LED in green.



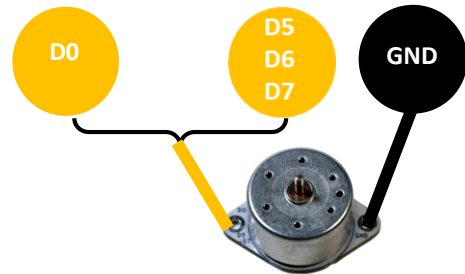
Show three different colours: red when your hand is very close (less than 20cm), yellow when it is less than 50cm, and green when more than 50cm.

DC Motor

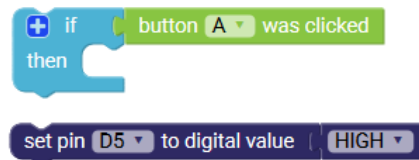
K018

Connecting a DC Motor; starting and stopping it on button click.

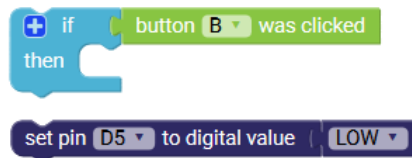
1 Connect the DC Motor via **D5** and **GND**.



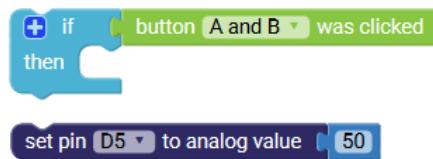
2 When button A is clicked, then start the motor.



3 When button B is clicked, then stop the motor.



4 When buttons A and B are both clicked, the make the motor turn slowly.

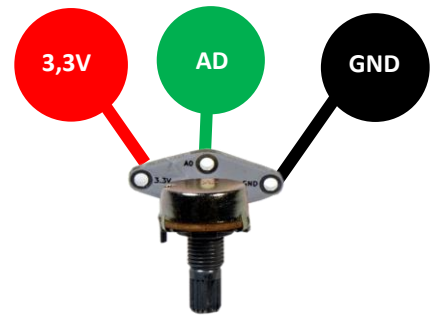


Potentiometer

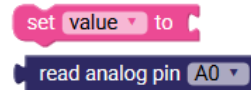
K019

Connecting a potentiometer and setting the colour of the RGB LED based on its value.

- 1 Connect the potentiometer via **3.3V**, **A0** and **GND**.



- 1 Read the analog value of the potentiometer and store it in a variable **value**.



- 2 Create a hue from the value and set the RGB LED to this hue.



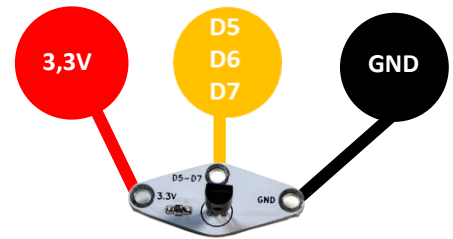
Instead of changing the hue, change the brightness of the RGB LED using the value of the potentiometer.

Coloured temperature display

K020

Connecting a temperature sensor, reading the temperature and colouring the RGB LED accordingly.

1 Connect the temperature sensor via **3.3V**, **D5** and **GND**.



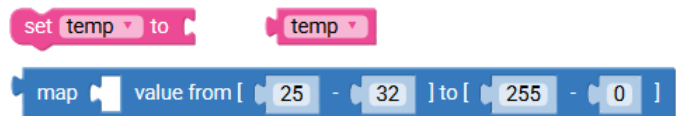
2 Read the temperature and store it into a variable temp.



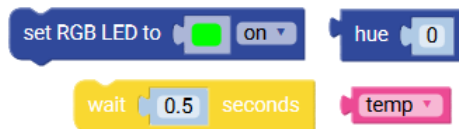
3 Write the temperature on the matrix.



4 Change temp: instead of having a value between 25-32 map it to 255-0



5 Use temp as hue value and colour the LED with this hue.



Used elements

Sensors

Variables

Matrix

Math

LED

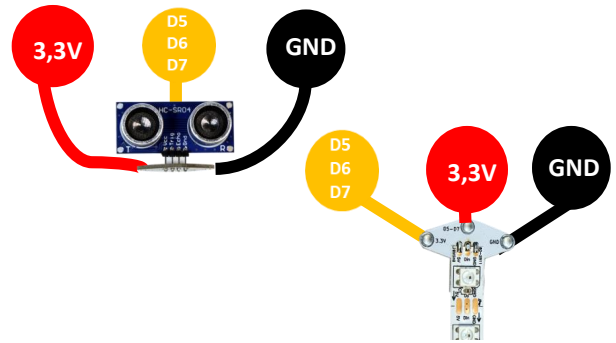
Time

Distance sensor and Neopixel LED strip

K021

Connecting an input and an output extension. Showing the distance visually on the LED strip: every 10 cm another LED lights up.

- Connect:
 - a distance sensor via **3.3V**, **D5** and **GND**
 - a neopixel LED Strip via **3.3V**, **D6** and **GND**



- Initialize a strip of 5 Neopixel LEDs on the pin D6.

Neopixel LED Strip with size **5** on pin **D6**

- Read the distance and store it in a variable **value**.

set **value** to
HC-SR04 read distance [cm] on Pin **D5**

- Check if the distance is less or equal to 50 cm.

if
then
value is **<** 50

- If yes, calculate the position of the pixel to be switched on, by dividing the distance by 10.

set pixel to
10 value

- Write the pixel on the matrix.

write a text on the matrix "Hello" repeating
pixel

- Activate this pixel on the strip.

set pixel **0** to color: pixel

- Wait 300 ms and then switch it off again.

wait **300** milliseconds
stop strip effect

Used elements

Sensors

LED

Variables

Matrix

Math

Time

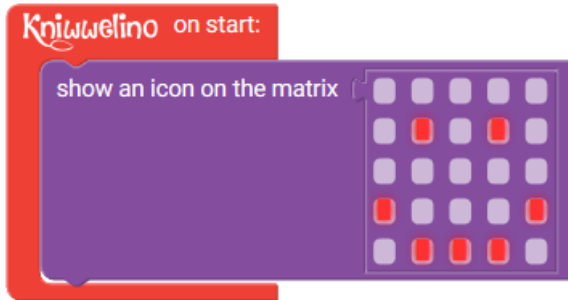


SOLUTIONS



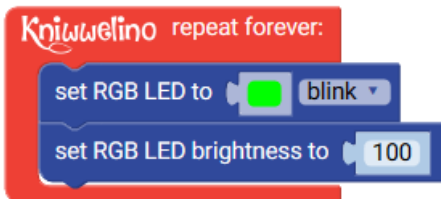
Matrix

K001



The coloured LED

K002



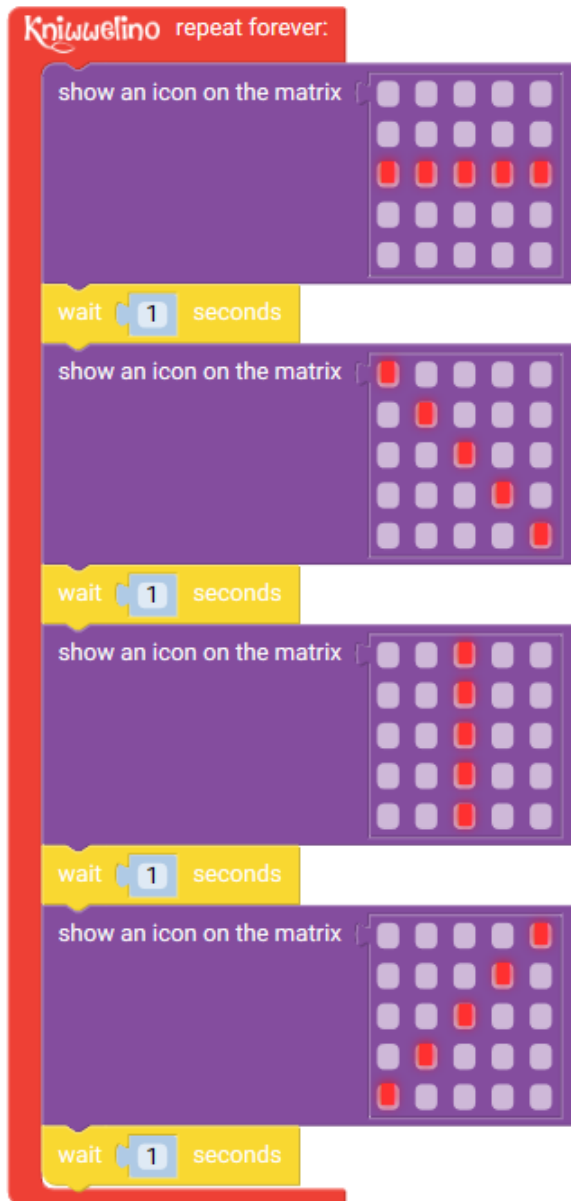
Change of Colour

K003



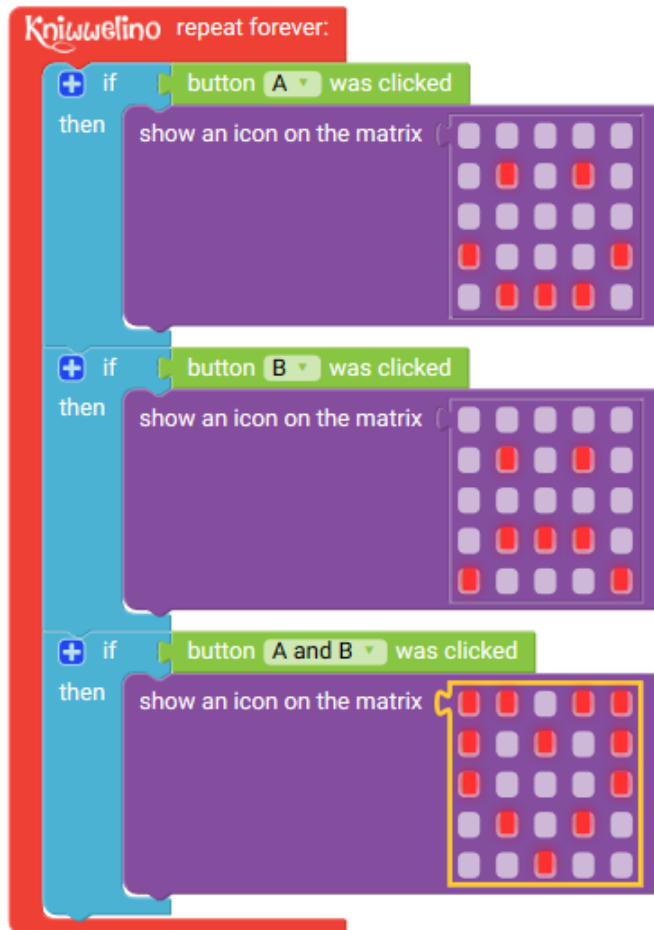
Animation

K004



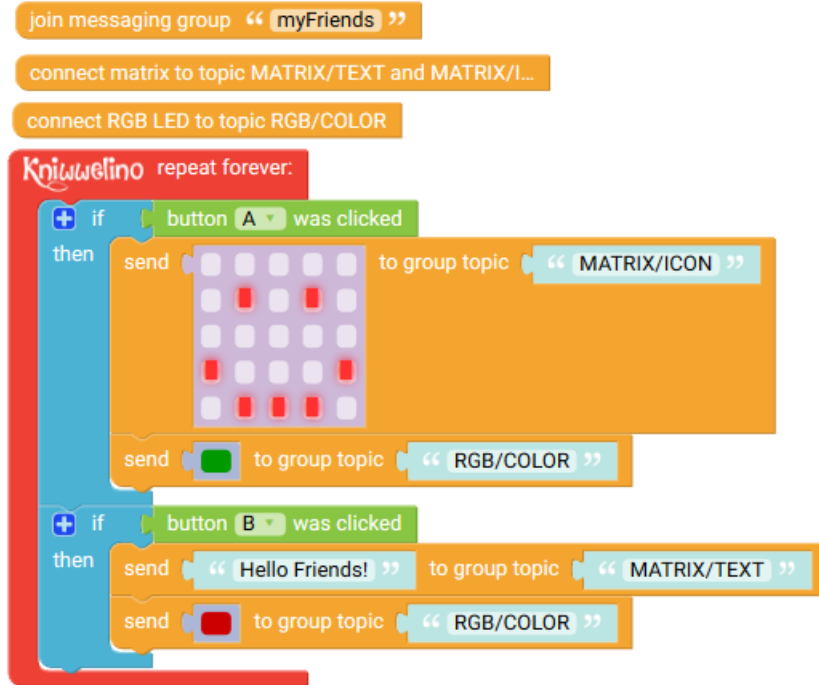
Button and matrix

K005



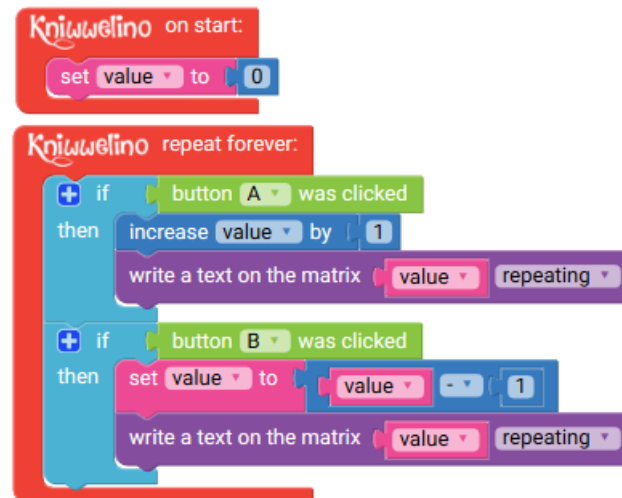
Messages

K006



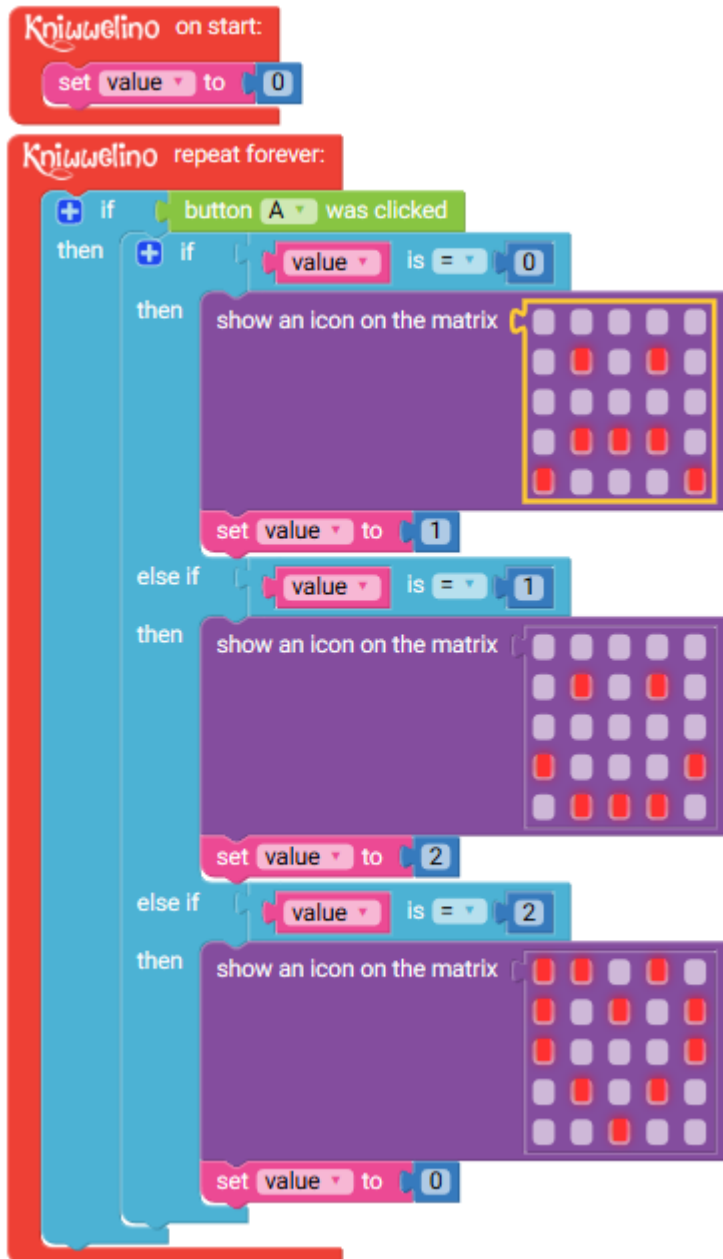
Variables

K007



Variable and logic

K008



Time and Mathematics

K009

```

Kniwwelino repeat forever:
  + if button A was clicked
  then
    clear matrix
    set start to current elapsed time (seconds)
    set RGB LED to on
  + if button B was clicked
  then
    write a text on the matrix
      current elapsed time (seconds) - start repeating
    switch RGB LED off
  
```

Matrix and Loops

K010

```

Kniwwelino repeat forever:
  count with i from 0 to 4 by 1
  do
    draw a pixel on the matrix X i Y 0 LED state 1
  wait 1 seconds
  clear matrix
  
```

External LED

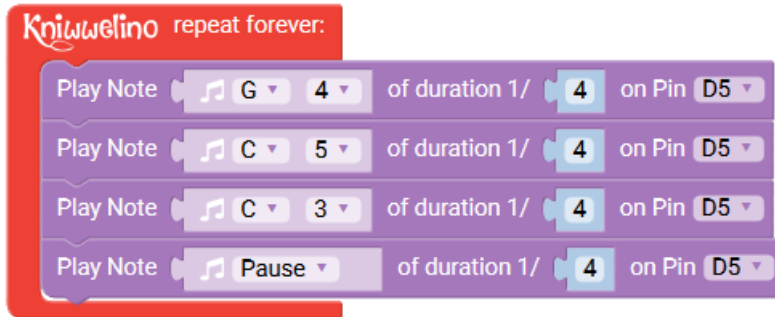
K011

```

Kniwwelino repeat forever:
  set external LED on pin D0 to blink
  
```

Buzzer

K012



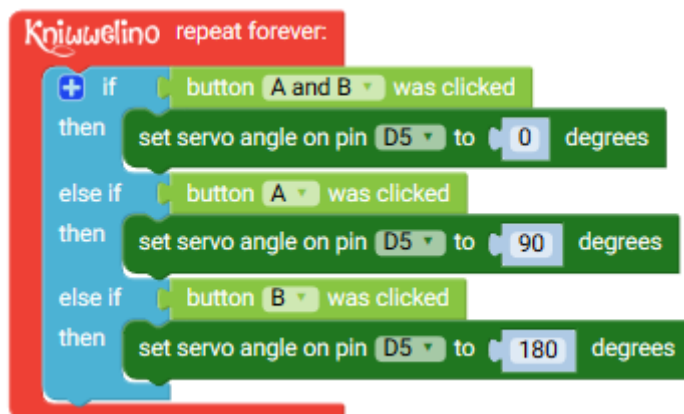
External Button

K013



Servo motor SG90

K014



Neopixel LED Strip

K015

```

Neopixel LED Strip with size 5 on pin D5
Kniwwelino repeat forever:
  set strip to effect: RUNNING_LIGHTS [18]
  
```

Temperature Sensor DS18B20

K016

```

Kniwwelino repeat forever:
  set value to DS18B20 read temperature [°C] on Pin D5
  write a text on the matrix value once and wait
  
```

Distance sensor HC-SR04

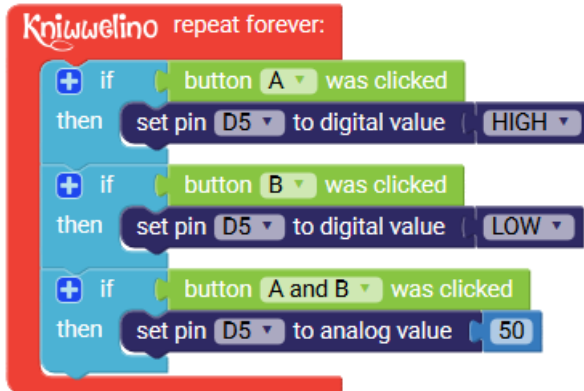
K017

```

Kniwwelino repeat forever:
  if HC-SR04 read distance [cm] on Pin D5 is < 50
  then
    set RGB LED to red on
  else
    set RGB LED to green on
  
```

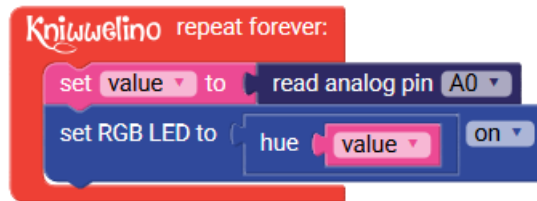
DC Motor

K018



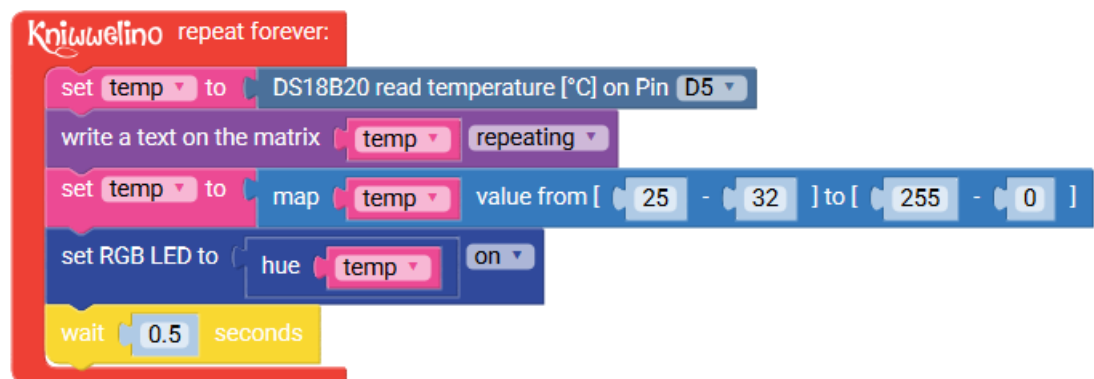
Potentiometer

K019



Coloured temperature display

K020



Distance Sensor and RGB LED Strip

K021

```

Neopixel LED Strip with size 5 on pin D6

Kniwwelino repeat forever:
  set value to HC-SR04 read distance [cm] on Pin D5
  if value is < 50
  then
    set pixel to value ÷ 10
    write a text on the matrix pixel repeating
    set pixel pixel to color: green
    wait 300 milliseconds
    stop strip effect
  
```