



Lesson 5:

Data Collection with Drones

Environmental Restoration with Drones – Advanced Automation

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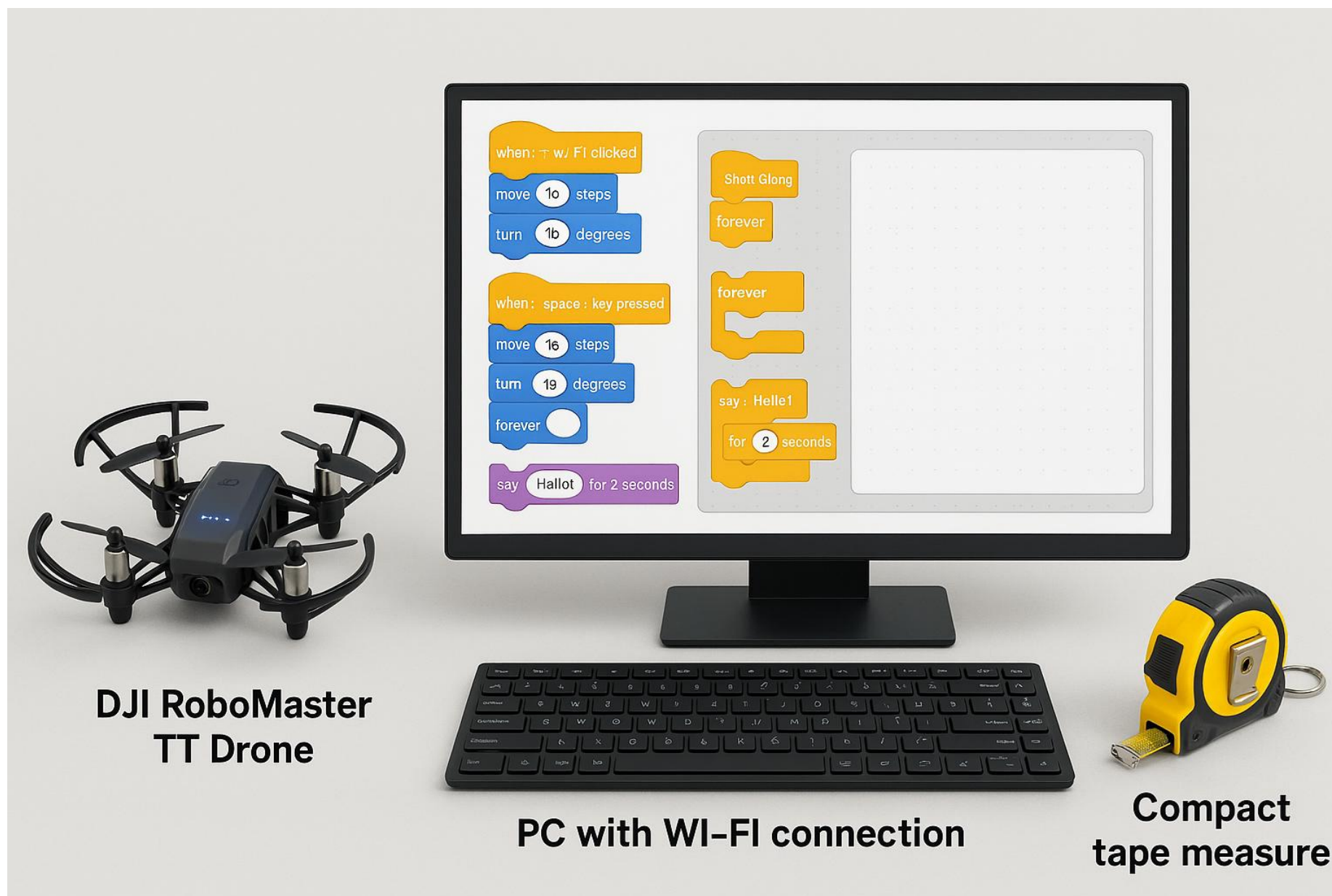
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Lesson Objectives

Explain that students will learn to operate a drone.

Explain that students will learn to measure and collect data with drone.

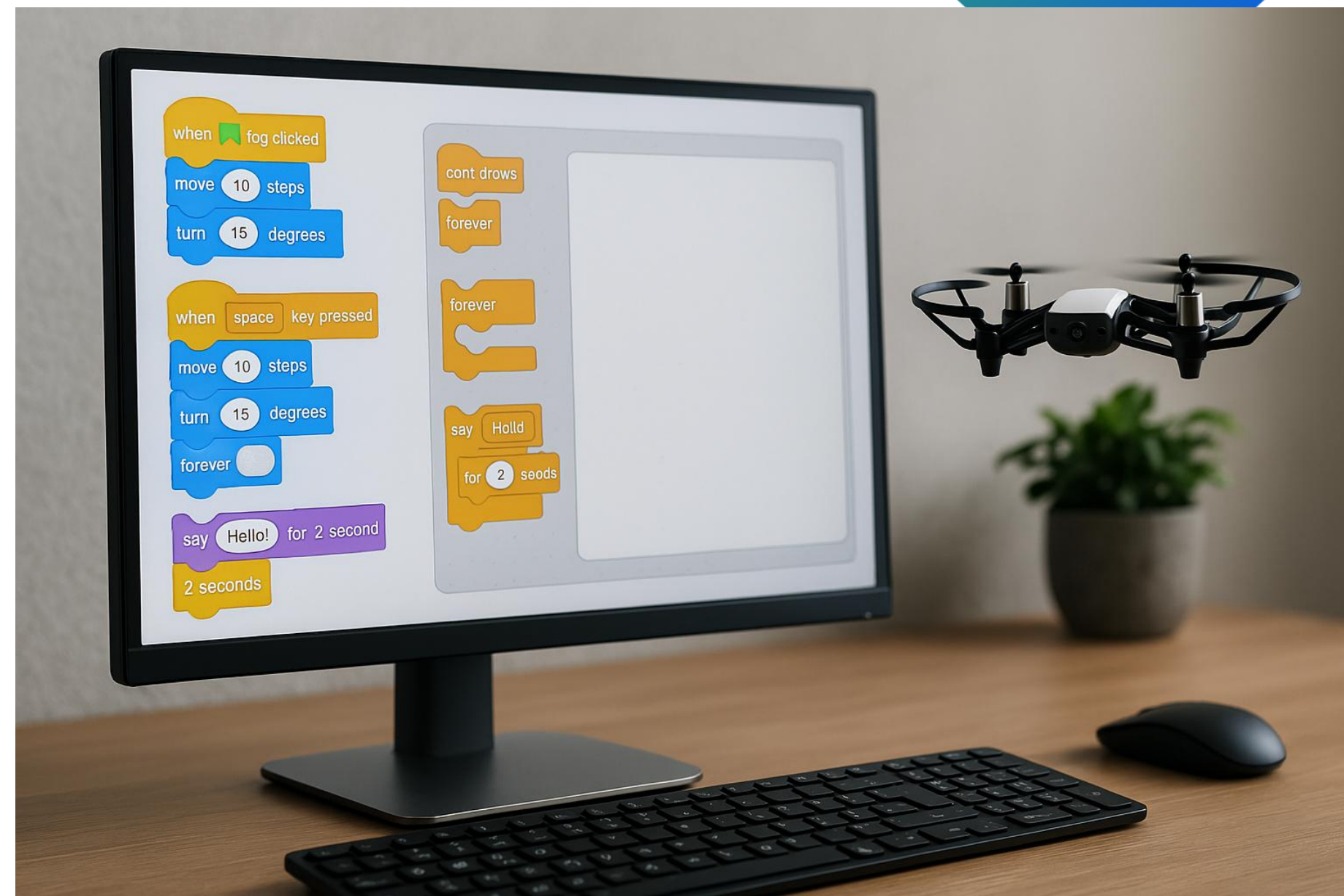
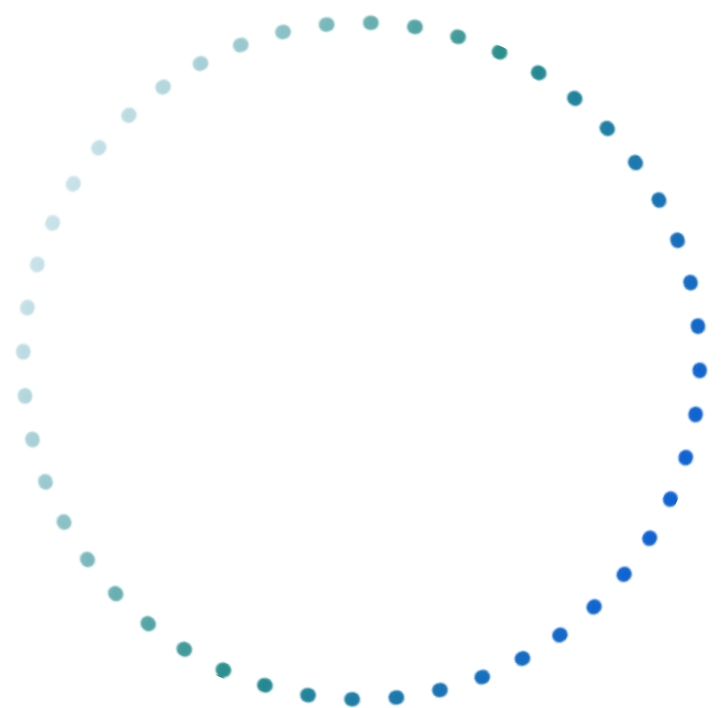
Materials Needed



DJI Robomaster TT Drone,
PC with WI-FI connection,
MIND+ Scratch GUI Platform,
Compact tape measure

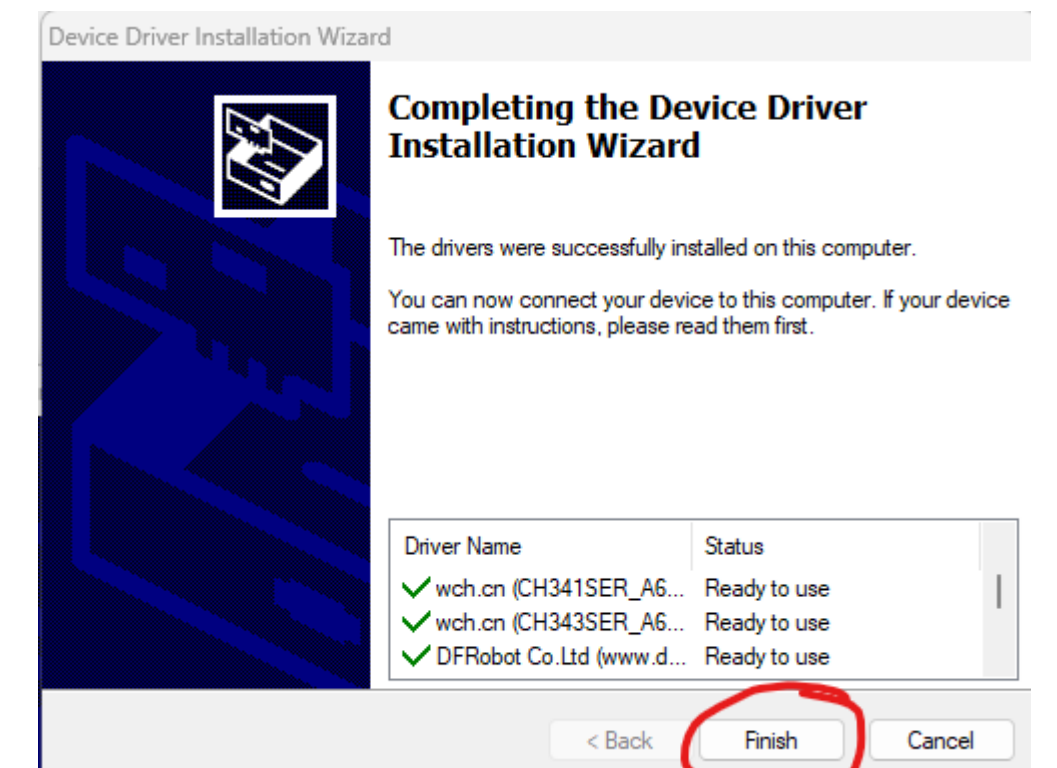
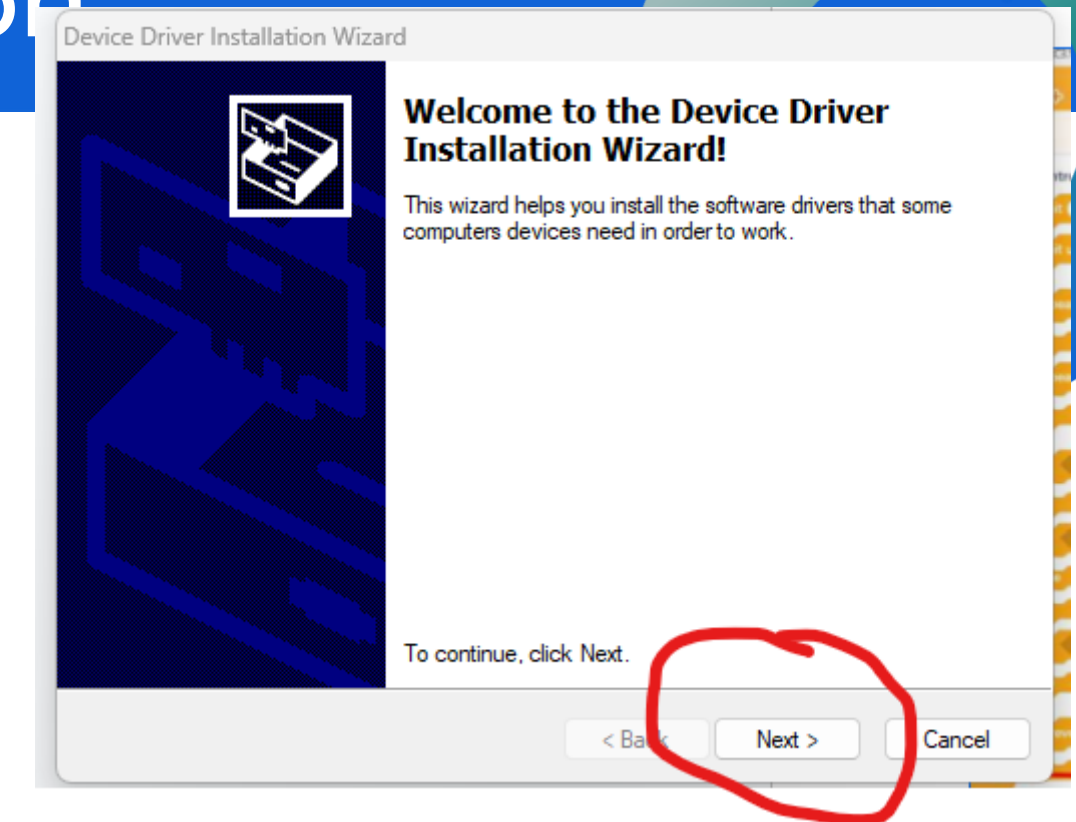
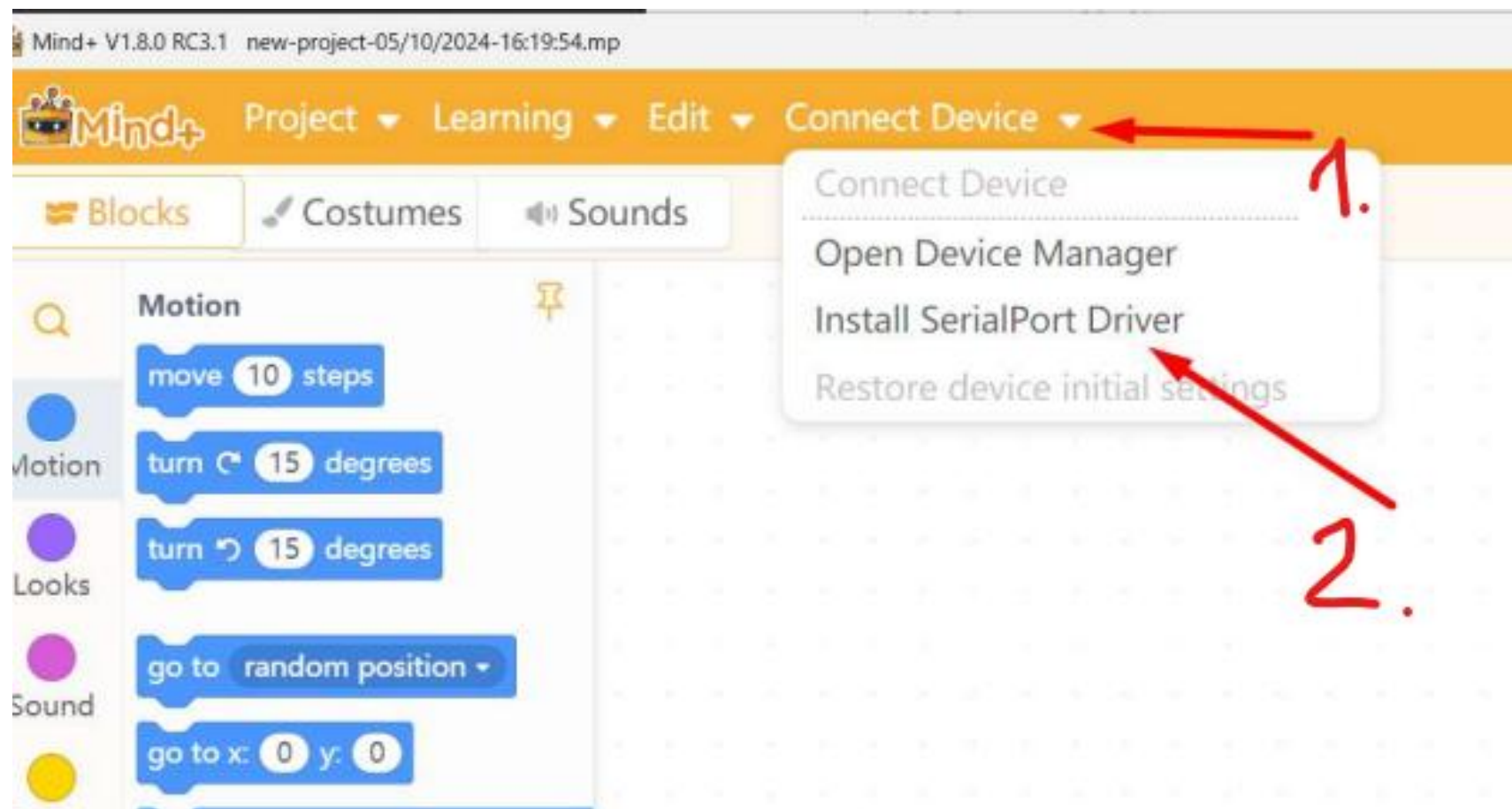
Establishing connections for drone operation

- Connection between Mind+ and TELLO drone
- Wi-Fi connection between PC and TELLO drone

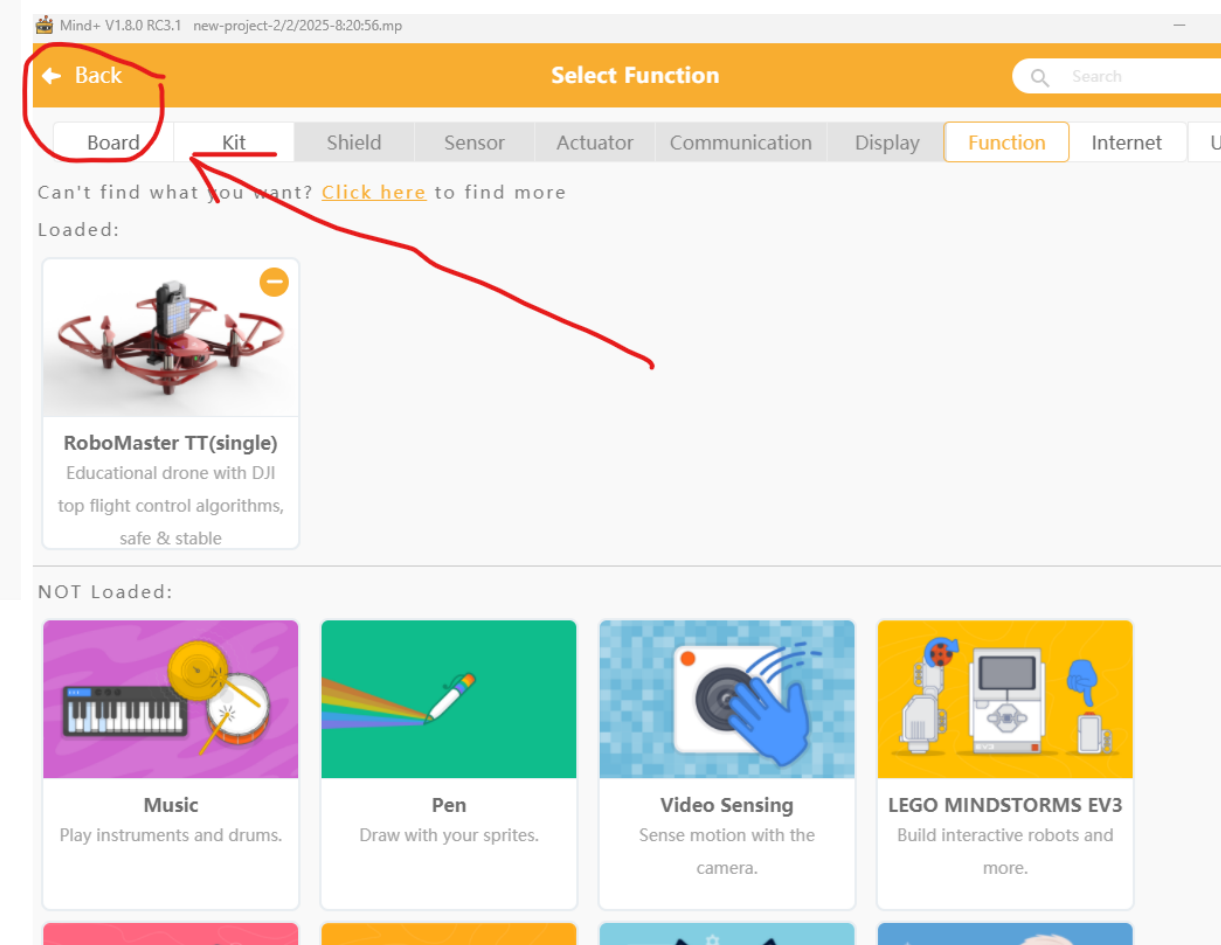
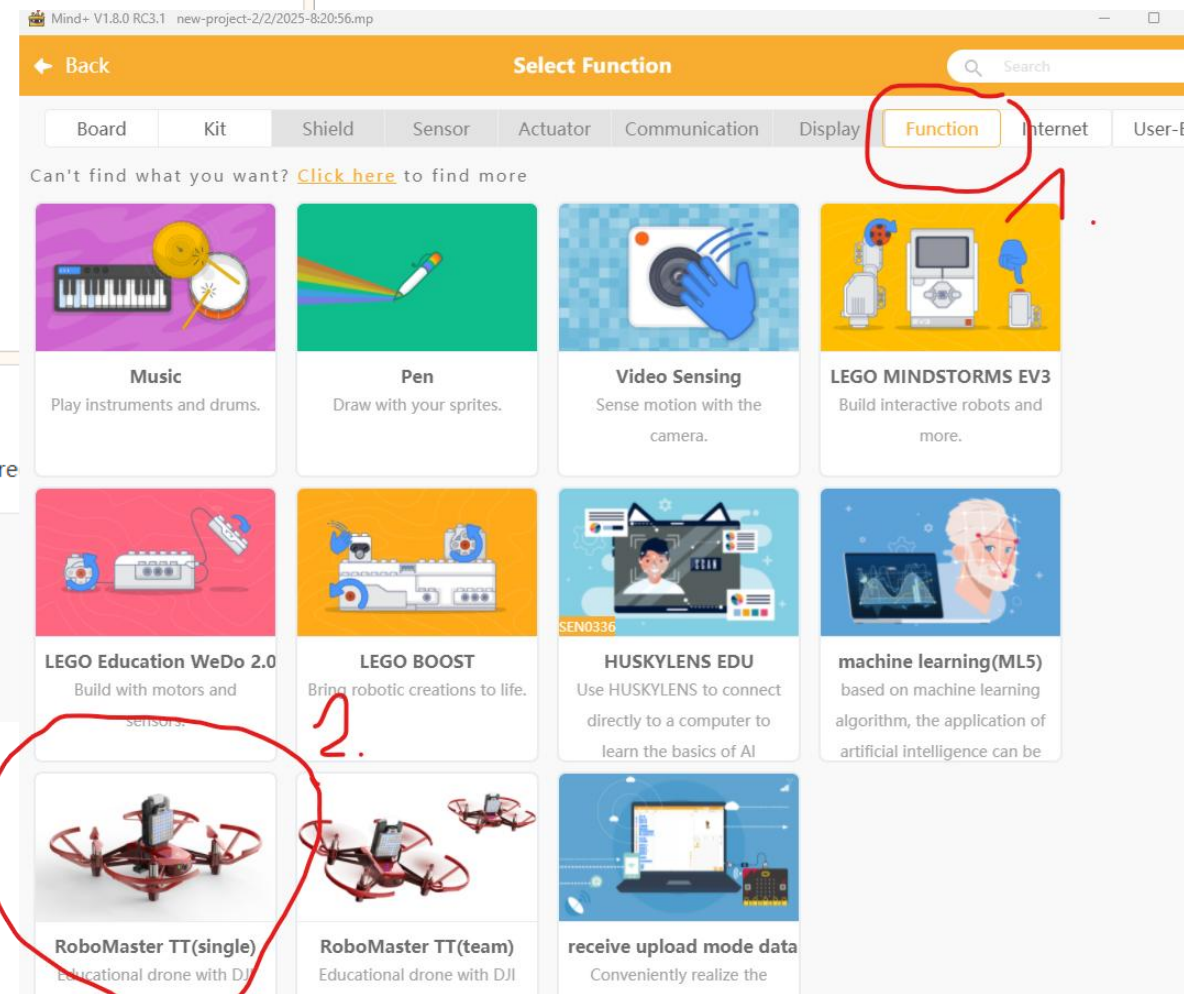
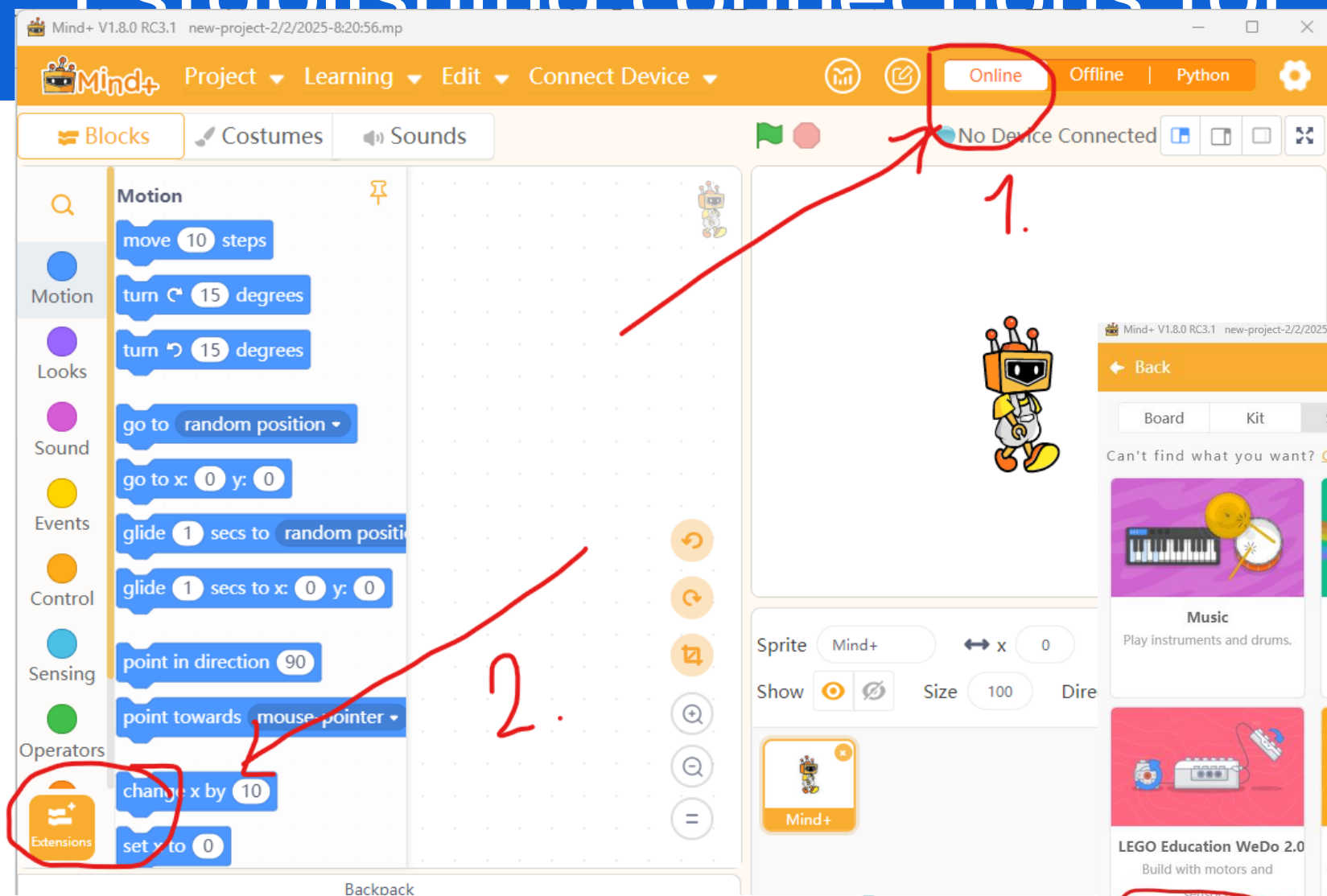


Establishing connections for drone operation

In the Mind+ program, we need to set certain functions that manage the connection between the Tello drone and the Mind+ program.



Establishing connections for drone operation



Establishing connections for drone operation

SIMPLE PROGRAM

The screenshot displays the Mind+ V1.8.0 RC3.1 interface. The top menu bar includes 'Project', 'Learning', 'Edit', and 'Connect Device'. The left sidebar shows various function categories: Motion, Looks, Sound, Events, Control, Sensing, Operators, Variables, and My Blocks. The main workspace contains a script for a 'RoboMaster TT(single)' drone. The script includes the following blocks:

- turn Tello's video open
- Enter propeller mode
- Exit the propeller mode
- take off
- Throw away in 5 seconds
- land
- fly up 50 cm
- fly down 50 cm
- fly left 50 cm
- fly right 50 cm
- fly forward 50 cm

Two event blocks are also present:

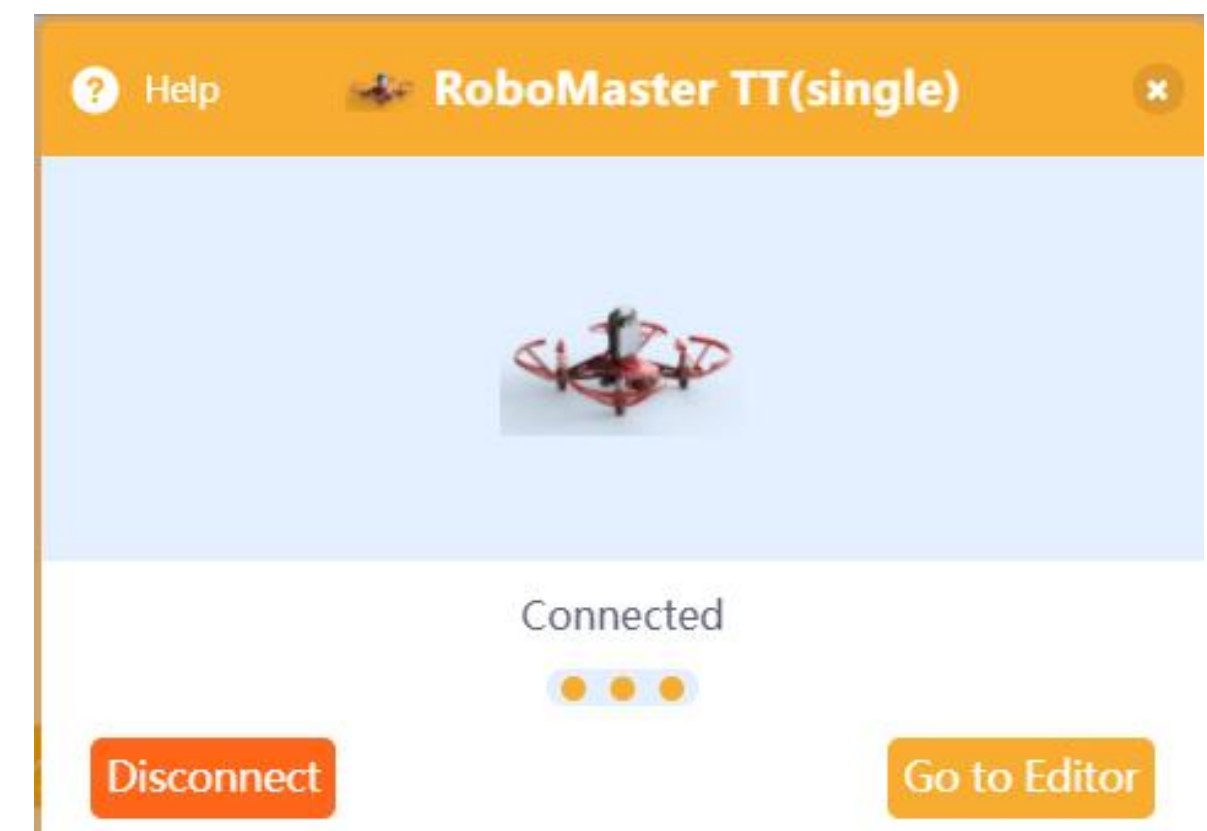
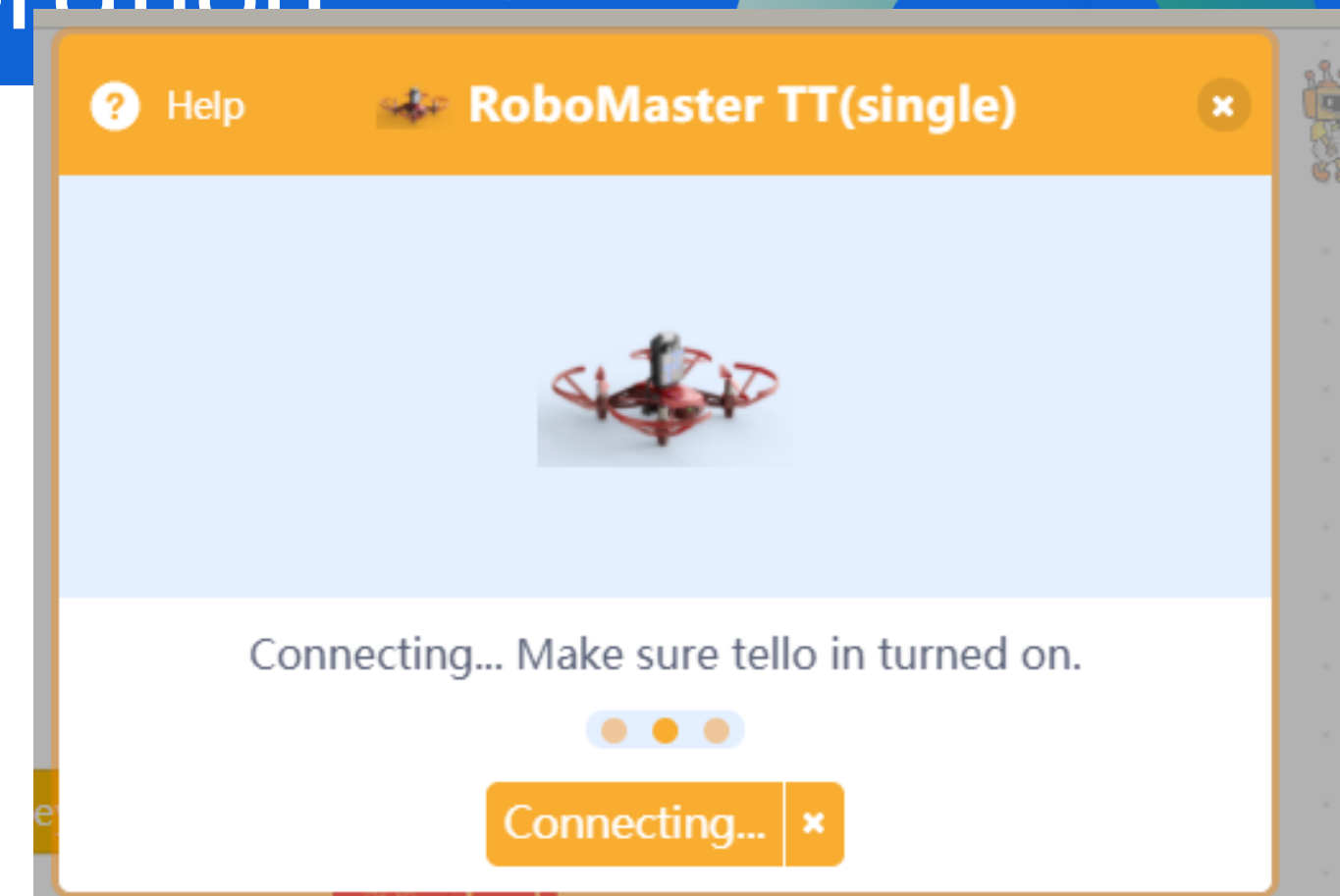
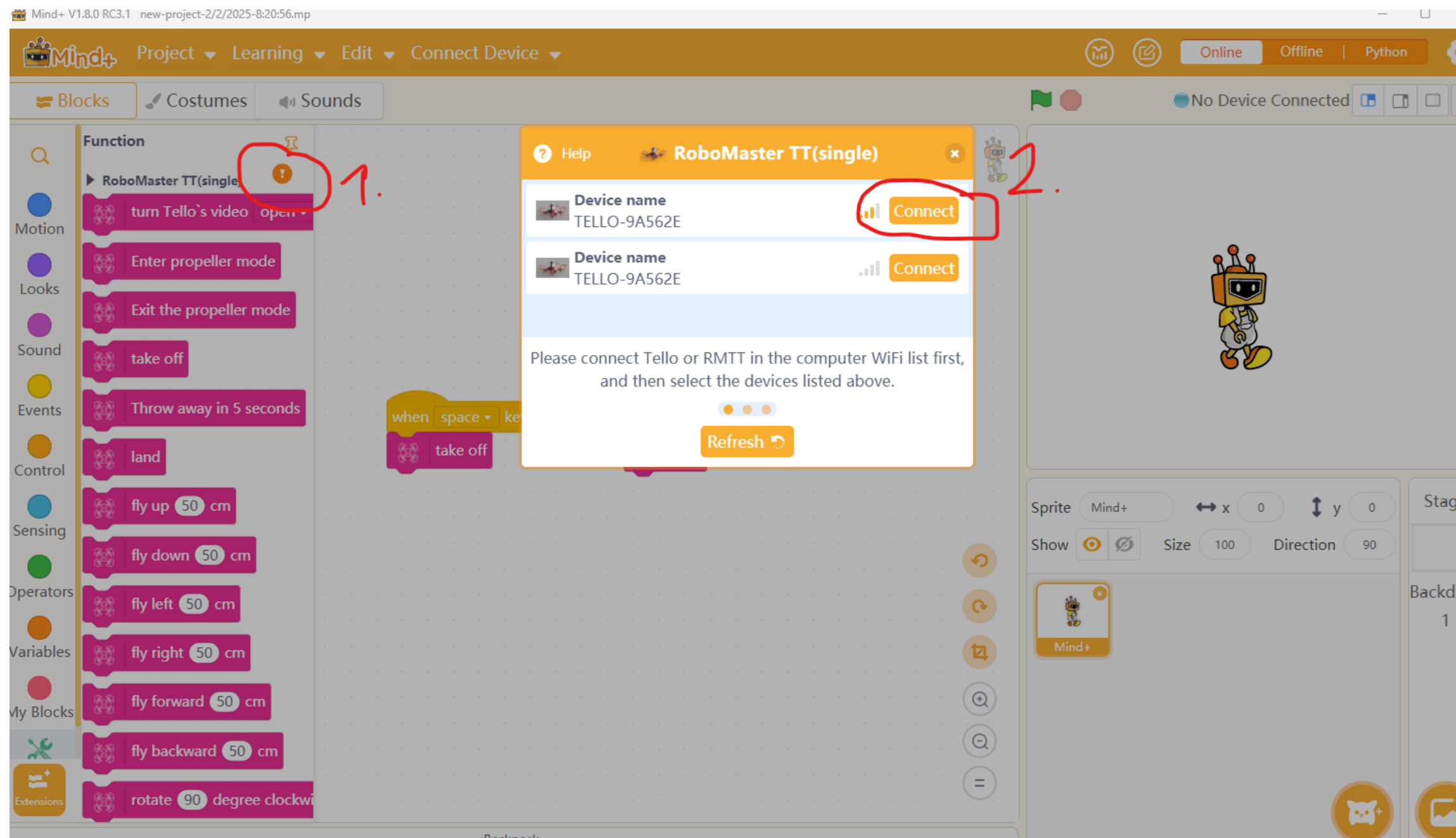
- when space key pressed
- when a key pressed

Red arrows and a red oval highlight the 'take off' and 'land' blocks, indicating the primary actions for drone operation. The right sidebar shows the 'Sprite' section with a 'Mind+' sprite and a 'Show' button. The bottom right corner displays the 'Size' and 'Direction' settings.

Establishing connections for drone operation

- The next step is to turn on the drone and enable your computer's Wi-Fi.
Among the available Wi-Fi devices detected by your computer, select the device named TELLO.
- Then, in the Mind+ program, select the left tab "MyBlocks", and click the exclamation mark next to "RoboMaster TT (single)". This will establish a connection between the Tello drone and the Mind+ program.

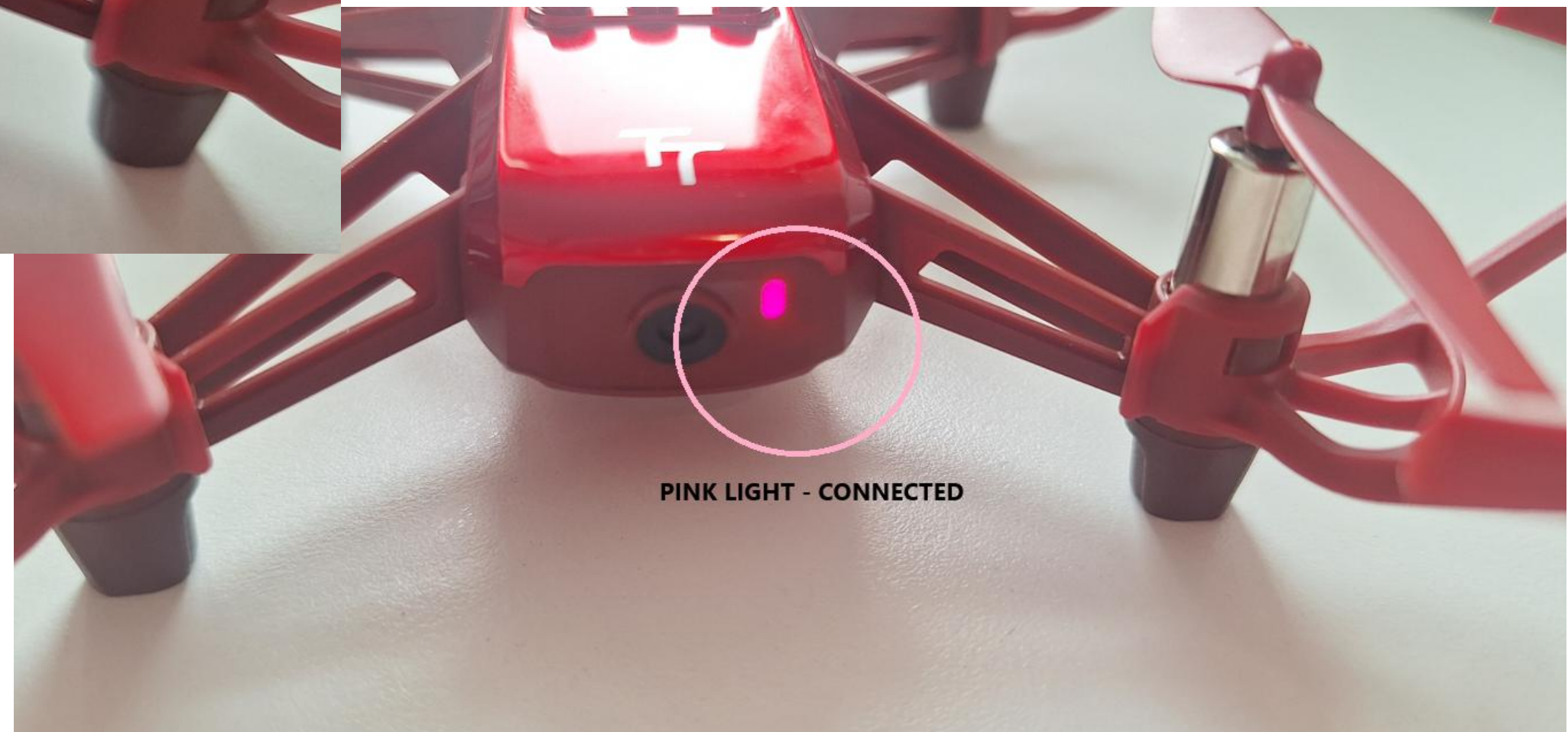
Establishing connections for drone operation



Establishing connections for drone operation



RED LIGHT NO CONNECTION !



PINK LIGHT - CONNECTED

Indoor Drone Flying Safety Rules

1

Before the Flight:

- Inspect the Drone
 - Check for damage or loose propellers.
 - Ensure the battery is fully charged.
- Prepare the Area
 - Remove obstacles like chairs, desks, and other items.
 - Ensure a spacious and open environment.
 - Close Windows or air stream sources
- Inform Participants
 - Brief everyone on safety protocols.
 - Maintain a safe distance of at least 2 meters from the drone.

Indoor Drone Flying Safety Rules

2 During the Flight:

- Controlled Take-off and Landing
 - Launch and land on a flat, stable surface.
 - Avoid flying near people or objects.
- Flight Boundaries
 - Keep the drone within visual line-of-sight.
 - Fly at low altitudes to avoid ceiling impact.
 - Land when battery <20%
- Emergency Protocol
 - Stop the drone immediately if it veers out of control. (SPACE initiates LANDING)
 - Use the "emergency stop" button on the app if needed. ("e" stops motors)

Indoor Drone Flying Safety Rules

3 After the Flight:

- Power Off Safely
 - Turn off the drone and disconnect the battery.
- Inspect for Damage
 - Check for any issues after flight.
- Store Safely
 - Keep the drone in a secure, dry place.

ALWAYS STAY CALM AND FOCUSED

Variable and code functions, live demonstration and code walkthrough

- Introduce variables and blocks that will be used in the program code
- Explain and omit the safety program

Variable and code functions, live demonstration and code walkthrough

- Introduce variables and blocks that will be used in the program code
- Explain and omit the safety program

Step 1: Saftey part Events – When __ key pressed

Guide students to use the "When a key pressed" block to make the drone start operating based on the next step.



Step 2: Saftey part My Blocks – Land

Use the "land" block to safely land the drone.

Variable and code functions, live demonstration and code walkthrough



```
when green flag clicked
  take off
  turn Tello's video open
  wait 10 seconds
  fly up 50 cm
  fly forward 100 cm
  rotate 90 degree clockwise
  wait 20 seconds
  rotate 90 degree counter clockwise
  fly backward 100 cm
  wait 5 seconds
  turn Tello's video close
  land
```

The image shows a Scratch script for controlling a Tello drone. The script starts with a 'when green flag clicked' event block. It then contains a series of action blocks: 'take off', 'turn Tello's video open', 'wait 10 seconds', 'fly up 50 cm', 'fly forward 100 cm', 'rotate 90 degree clockwise', 'wait 20 seconds', 'rotate 90 degree counter clockwise', 'fly backward 100 cm', 'wait 5 seconds', 'turn Tello's video close', and 'land'.

Variable and code functions, live demonstration and code walkthrough

Step 1: Events – When __ key pressed

Guide students to use the "When s key pressed" block to make the drone start operating based on the next step.

Step 2: My Blocks – Take Off

Guide students to use the "take off" block to initiate the drone's flight.

Step 3: My Blocks – Turn Tello's video ____

Use the "Turn Tello's video open" block for the start of the display, the video will be played on the computer screen.

Step 4: Control- Wait __ seconds

Use the "Wait 10 seconds" block intended for the command to wait at a specific position for a certain amount of time.

Step 5: My Blocks – Fly up

Use the "fly up" block to move up the drone a 50 cm distance.

Step 6: My Blocks – Fly forward

Use the "fly forward" block to move forward the drone a 100 cm distance.

Step 7: My Blocks – Rotate __ degree clockwise

Use the "Rotate 90 degree clockwise" block is designed to rotate by a specified number of degrees in the clockwise direction.



Variable and code functions, live demonstration and code walkthrough

Step 8: Control- Wait __ seconds

Use the " Wait 20 seconds " block intended for the command to wait at a specific position for a certain amount of time.

Step 9: My Blocks – Rotate __ degree counter clockwise

Use the " Rotate 90 degree counter clockwise " block is designed to rotate by a specified number of degrees in the counter clockwise direction.

Step 10: My Blocks – Fly backward

Use the "fly backward " block to move forward the drone a 100 cm distance.

Step 11: Control- Wait __ seconds

Use the " Wait 5 seconds " block intended for the command to wait at a specific position for a certain amount of time.

Step 12: My Blocks – Turn Tello's video ____

Use the " Turn Tello's video close" block for the start of the display, the video will be played on the computer screen.

Step 13: My Blocks– Land

Use the "land" block to safely land the drone.

Variable and code functions, live demonstration and code walkthrough

The programs function are the same, but when programming, we need to define events more precisely when converting from block-based mode to structured text. Therefore, we used the "if" loop, while all other steps remain the same.

On the left side of the window, we have the block-based programming mode, and on the right side, we have structured text - Python

The screenshot displays a programming interface with two main panes. The top bar includes icons for online/offline status and a 'Python' mode selector. Below this are 'Run', 'Code Area', and 'File System' buttons. The left pane, titled 'Python main program start', shows a block-based script. It begins with an 'if' block containing a variable 's' and a 'letter' dropdown. The 'then' branch contains a sequence of drone control blocks: 'djitello_takeoff', 'djitello_streamon', a 'wait 10 seconds' block, 'djitello_moveup 50', 'djitello_moveforward 100', 'djitello_Srotate 90', another 'wait 20 seconds' block, 'djitello_Nrotate 90', 'djitello_moveback 20', a 'wait 5 seconds' block, 'djitello_streamoff', 'djitello_land', and finally 'djitello_land' at the bottom. The right pane, titled 'Auto Generate', shows the corresponding Python code. It starts with a UTF-8 encoding declaration, followed by comments for 'MindPlus' and 'Python', and an 'import time' statement. The code then uses an 'if' statement with 's.isalpha()' to trigger a series of actions: 'tello.takeoff()', 'tello.streamon()', 'time.sleep(10)', 'tello.move_up(50)', 'tello.move_forward(100)', 'tello.rotate_clockwise(90)', 'time.sleep(20)', 'tello.rotate_counter_clockwise(90)', 'tello.move_back(20)', 'time.sleep(5)', 'tello.streamoff()', and 'tello.land()' twice. At the bottom, a 'Terminal' pane shows an error message: 'e 9, in <module> tello.takeoff() NameError: name 'tello' is not defined'.

```
Python main program start
if "s" is letter ? then
  djitello_takeoff
  djitello_streamon
  wait 10 seconds
  djitello_moveup 50
  djitello_moveforward 100
  djitello_Srotate 90
  wait 20 seconds
  djitello_Nrotate 90
  djitello_moveback 20
  wait 5 seconds
  djitello_streamoff
  djitello_land
  djitello_land

Auto Generate
1  # -*- coding: UTF-8 -*-
2
3  # MindPlus
4  # Python
5  import time
6
7
8  if "s".isalpha():
9      tello.takeoff()
10     tello.streamon()
11     time.sleep(10)
12     tello.move_up(50)
13     tello.move_forward(100)
14     tello.rotate_clockwise(90)
15     time.sleep(20)
16     tello.rotate_counter_clockwise(90)
17     tello.move_back(20)
18     time.sleep(5)
19     tello.streamoff()
20     tello.land()
21     tello.land()
22

Terminal
e 9, in <module>
    tello.takeoff()
NameError: name 'tello' is not defined
```

Troubleshooting

1 Drone Connection

- Is the drone connected?
- Initiate connection again

2 Mission Start

- Did you add an event?
- Did you add the take off command?

3 Flight Path

- Check for correct commands
- Clockwise vs Counter Clockwise



Recap with Q&A Session

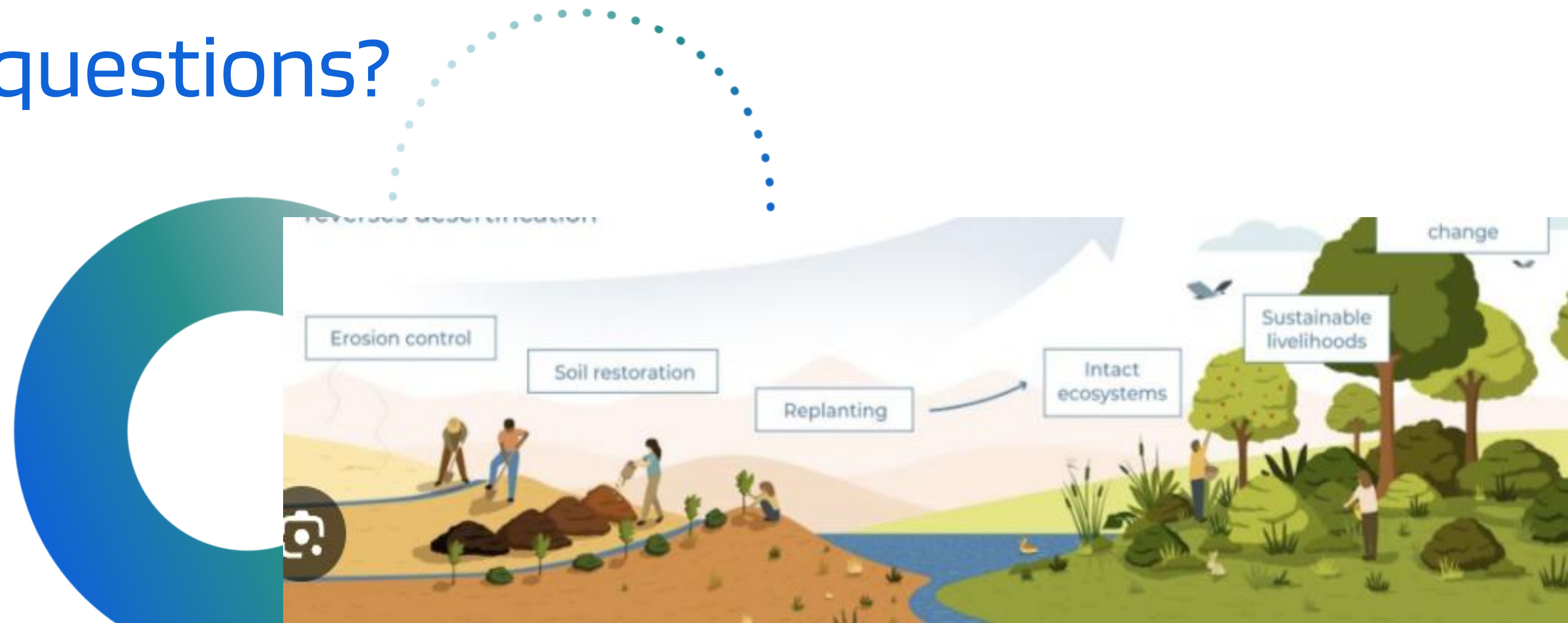
- Summarize the key steps in programming the drone.
- Highlight the importance of each programming block used.
- Open the floor for any questions from students.
- Address any issues or concerns encountered during the exercise.



Real World Applications

- Identifying and addressing problem areas.
- Automating data collection to save time and resources.
- Leveraging drones to improve restoration techniques efficiency and sustainability.

What are your questions?



Additional Resources

Further Reading

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.13912#:~:text=Drones%20are%20used%20in%20several,be%20transferred%20to%20r>

Videos

<https://www.youtube.com/watch?v=XhjN8Xux2I4>



Thank you for your
attention !



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