

Lesson 4:

Smart Farming

Programming Exercise – Creating a Simple Flight Path

Drones4STEM © 2023 by Drones4STEM is licensed under CC BY-NC-SA 4.0. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-sa/4.0/>

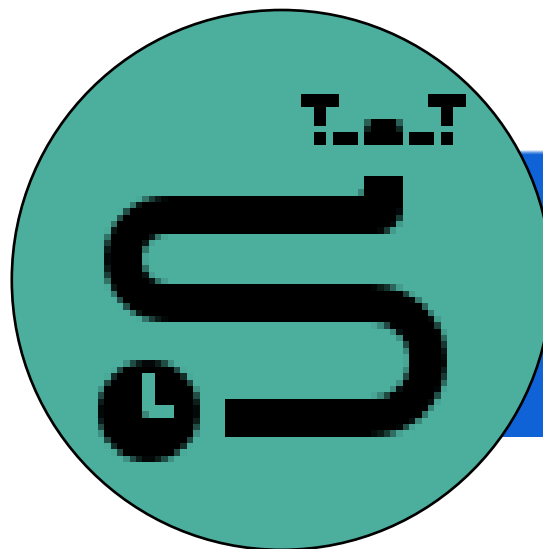


Co-funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

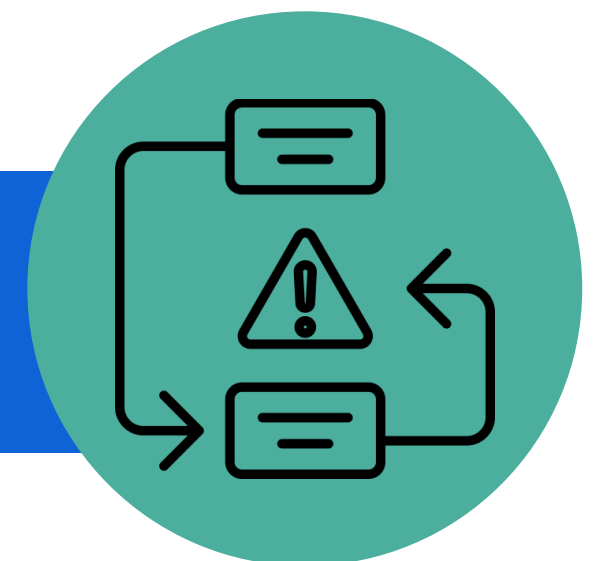
Lesson Objectives

Learn to use block-based programming to control a drone.

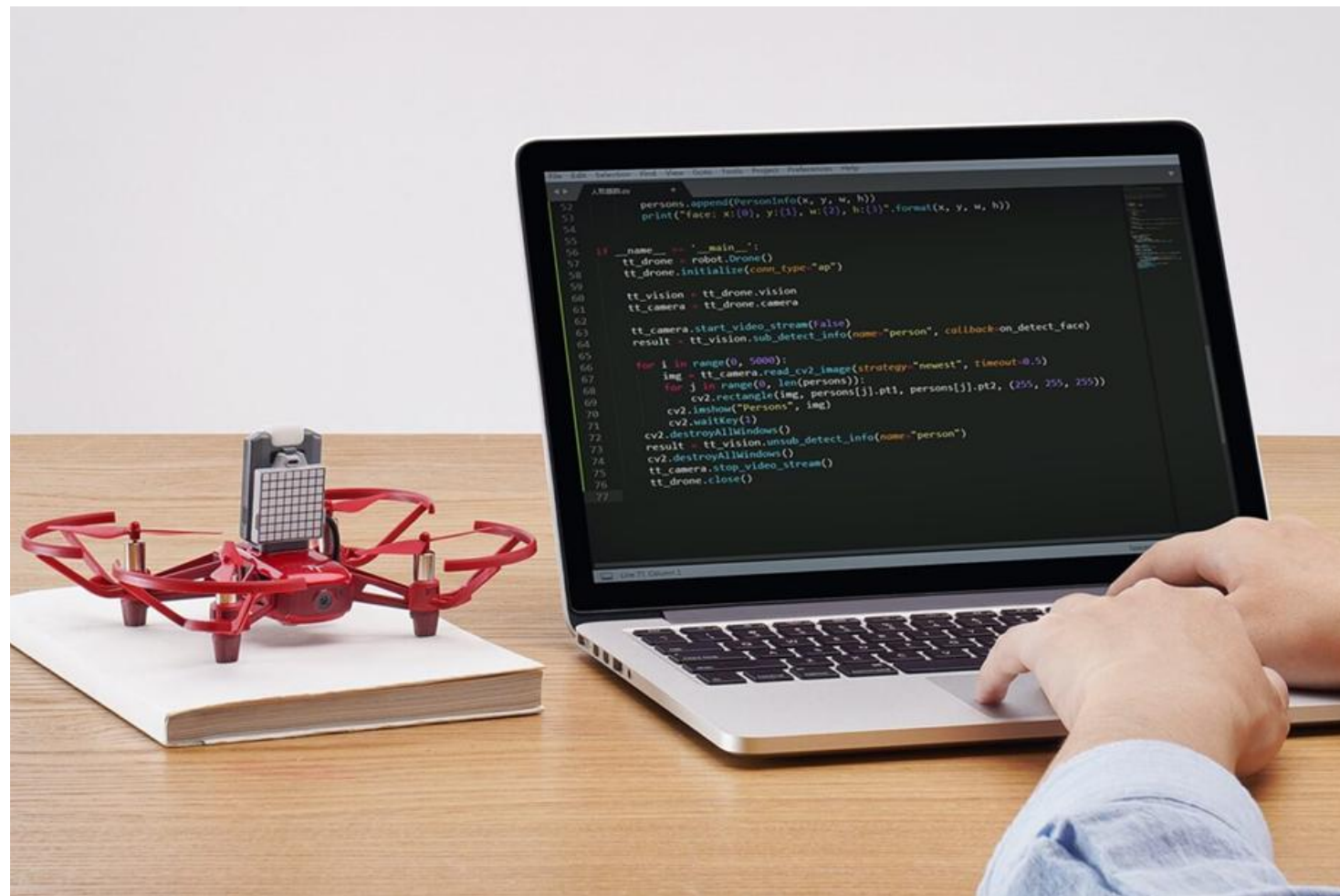


Program a drone to take off, fly in a square pattern, and land.

Discuss Safety Protocols and Emergencies



Materials Needed



HARDWARE

DJI Robomaster TT Drone

Drones4STEM FloorMat

PC SOFTWARE

MIND+ Scratch GUI Platform

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 Takeoff 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)

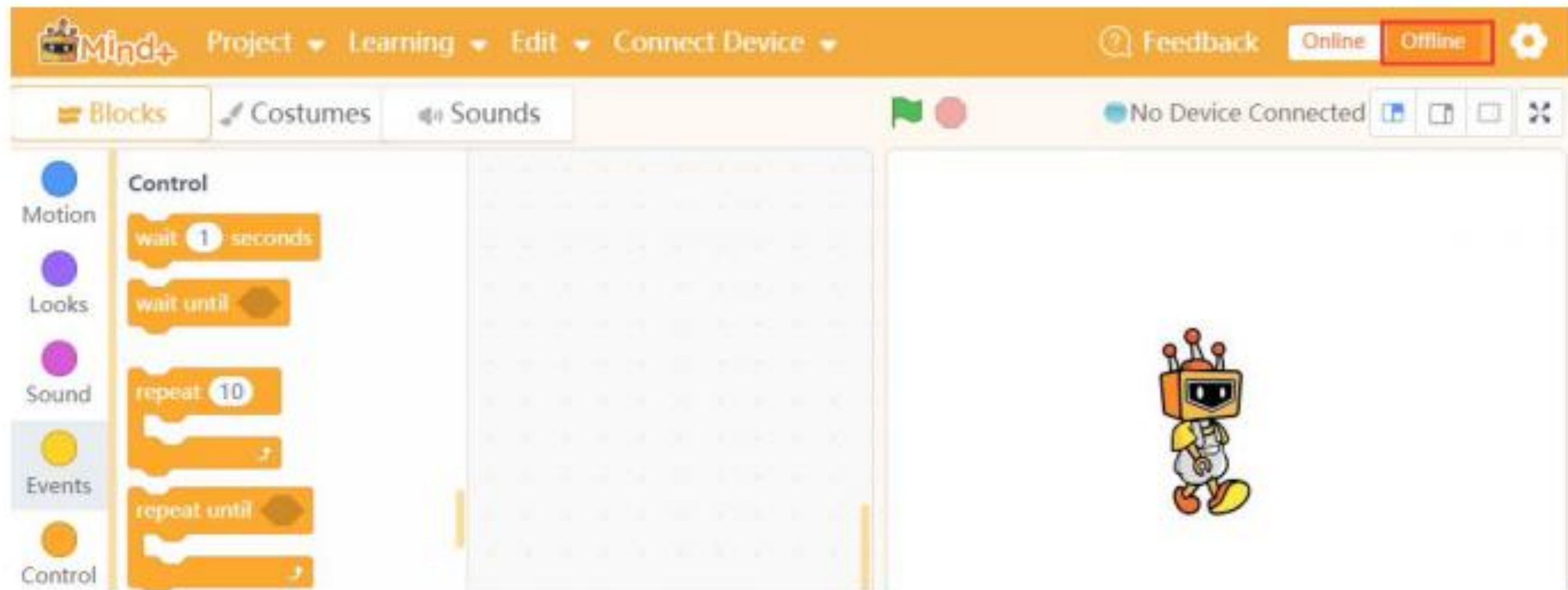
Indoor Drone Flying Safety Rules

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

Demonstration Of Block Based Programming



Introduction to MIND+

Installation CheckList

- Install from <https://mindplus.cc/>
- Choose EXTENSIONS->FUNCTIONS->ROBOMASTER (SINGLE)
- My Blocks
 - TELLO TT Specific functions (Camera,QR,ETC)

A screenshot of a Scratch script for a Tello drone mission. The script consists of the following blocks:

- Turn on Challenge Card Detection
- Set the detection position Down View
- fly to MissionPad x 50 cm y 50 cm z 80 cm with 50 cm/s Mid m-1
- Flying arc line under challenge card x1 20 cm y1 20 cm z1 80 cm and x2 40 cm y2 60
- Jump along challenge card x 100 cm y 0 cm z 80 cm speed 50 cm/s yaw 0 degree fr
- The aircraft rotates to the 0 angle relative to the challenge card m-1
- Challenge Card Number
- Challenge Cardx(cm)

A screenshot of the MIND+ interface showing the RoboMaster TT extension. The interface is divided into two main sections: Control and Function. The Control section includes Sensing, Operators, Variables, and My Blocks. The Function section includes RoboMaster TT(single), turn Tello's video, Enter propeller mode, Exit the propeller mode, take off, Throw away in 5 seconds, and land. The RoboMaster TT(single) block is highlighted with a red box, and the My Blocks section is also highlighted with a red box.

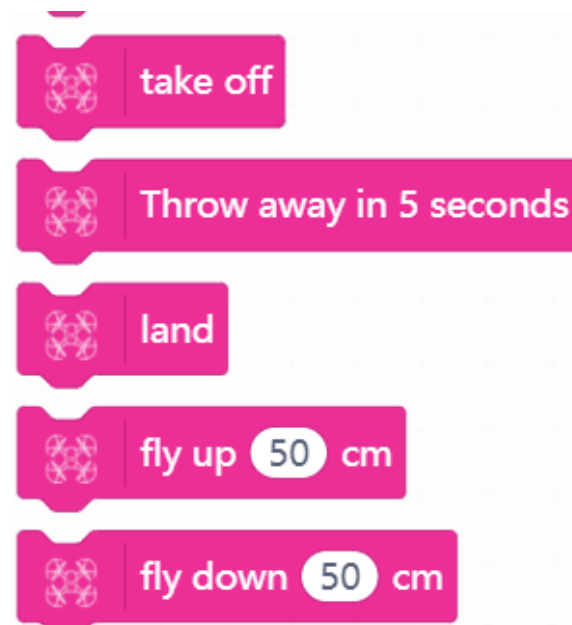
Control	Function
Sensing	RoboMaster TT(single)
Operators	turn Tello's video open
Variables	Enter propeller mode
My Blocks	Exit the propeller mode
	take off
	Throw away in 5 seconds
	land

Code Functions



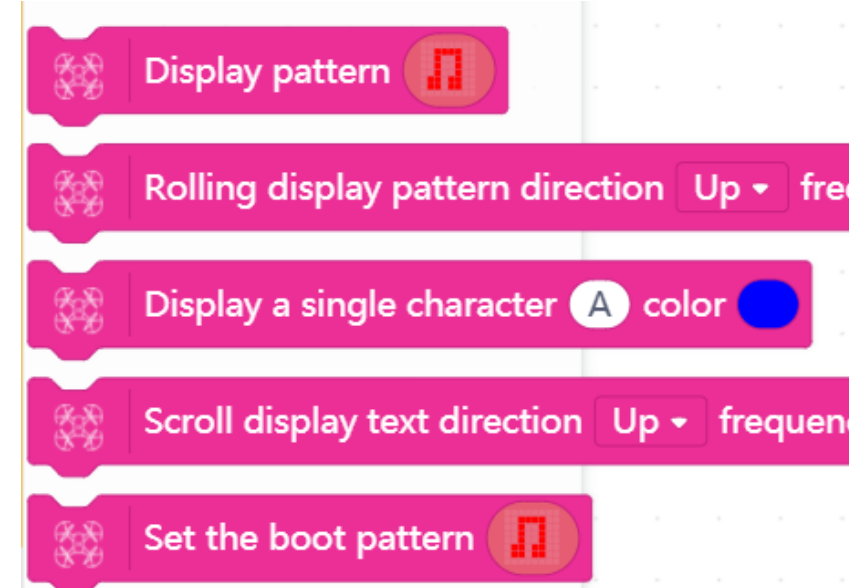
Flight Functions

- Take Off/Land
- Move
- Rotate
- Flip



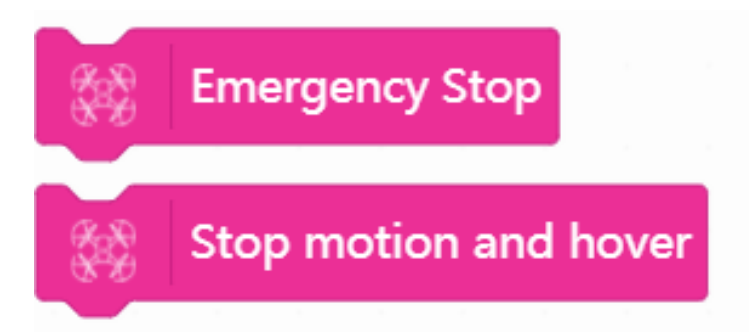
Events

- Challenge Cards Recognition
- Read Distance from obstacles
- Led Color
- Led Matrix Messages

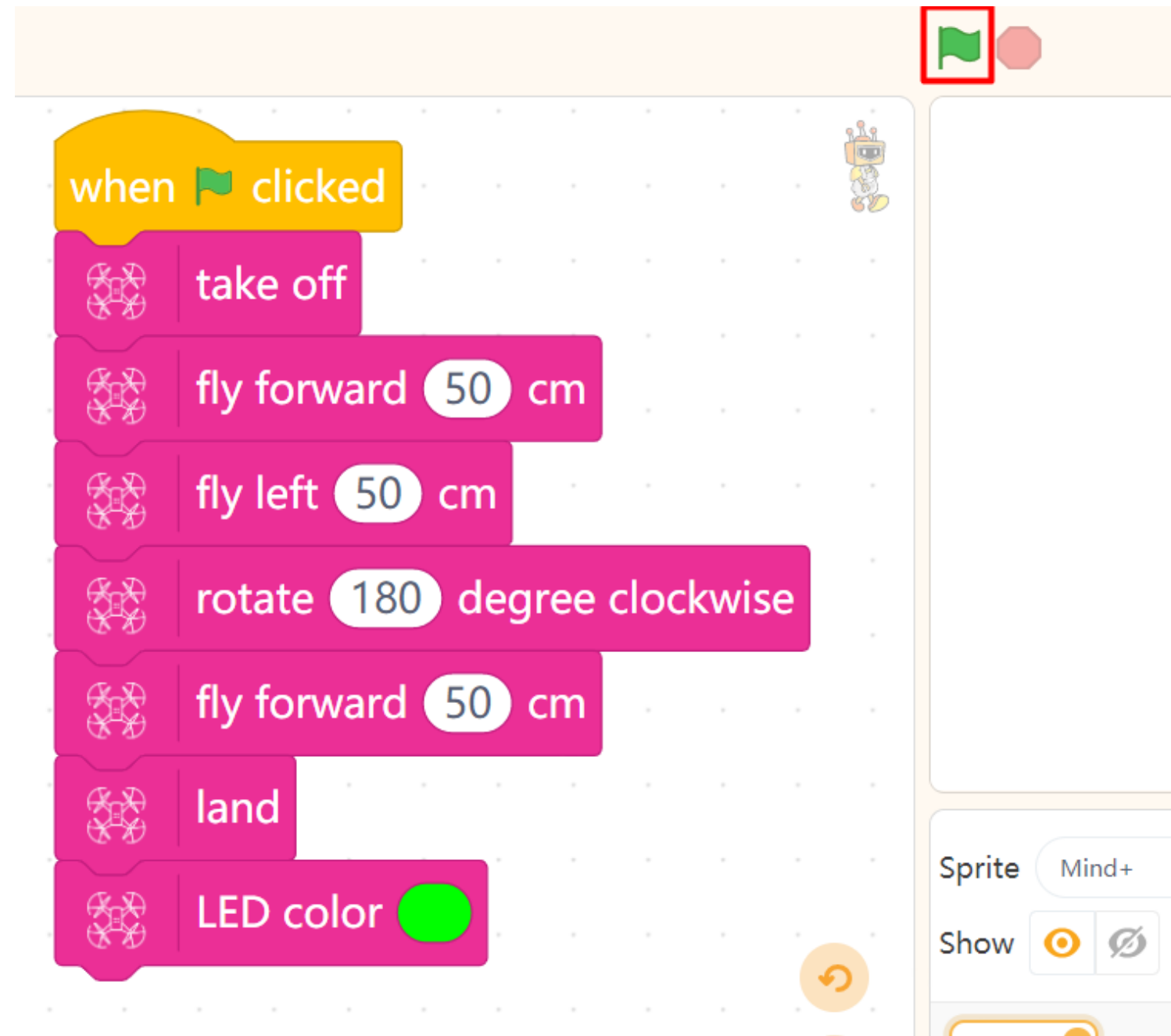
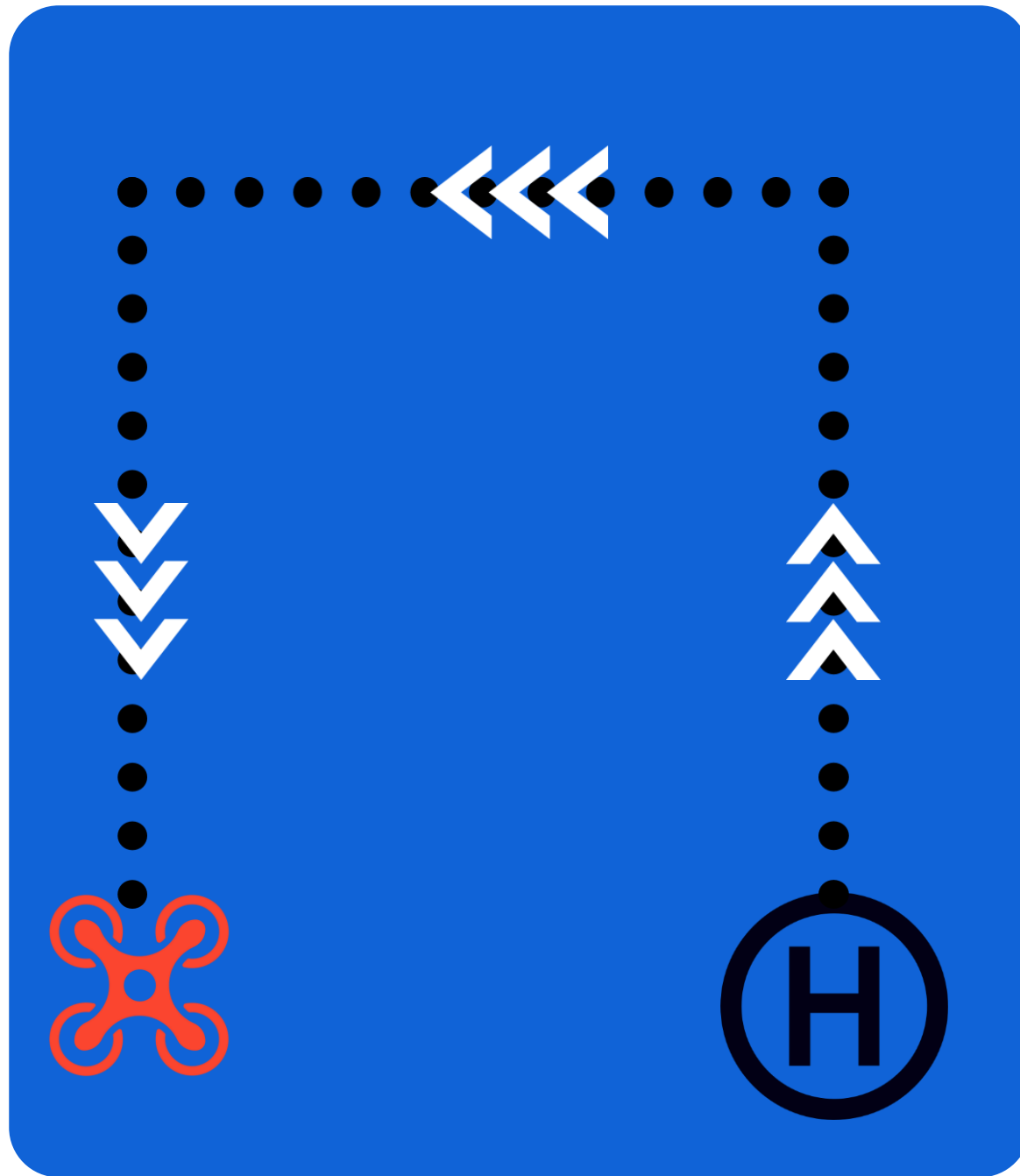


Safety Functions

- Emergency Stop
- Obstacle Avoidance



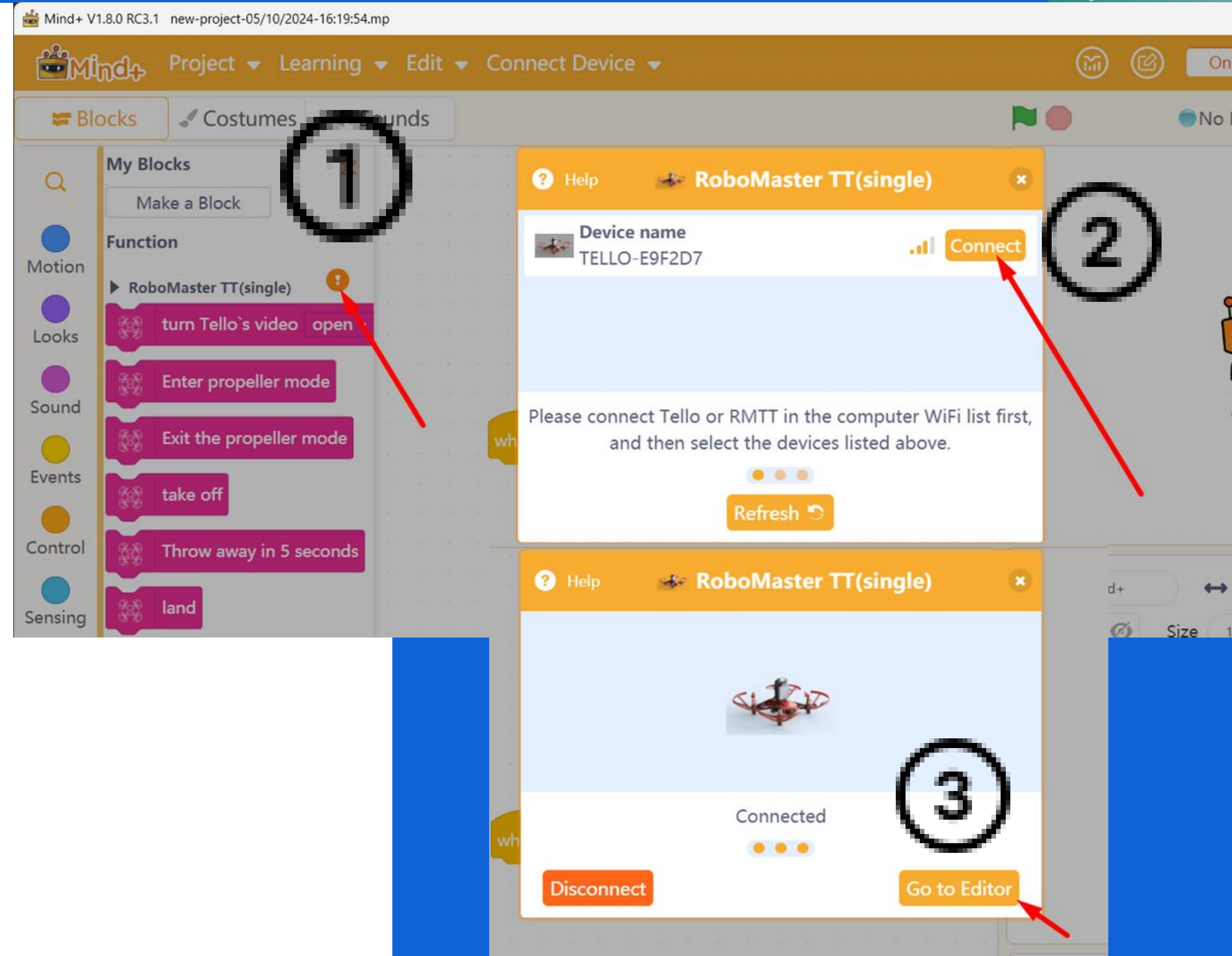
Example Code



Live Demonstration

Connection CheckList

- Insert Battery
- Connect PC to drone WIFI Hotspot
- My Blocks -> 
- Choose Device-> 
- After Connection ->
- Load Project-> Simple Flight



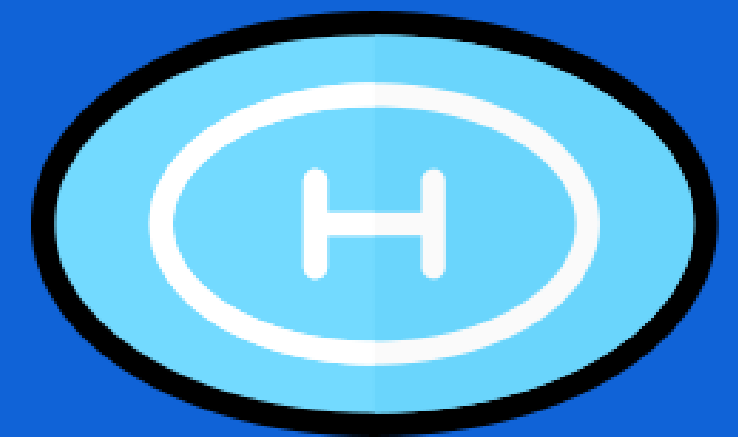
Live Demonstration (Simple Flight Project)

```
when green flag clicked
  take off
  fly forward 50 cm
  rotate 180 degree clockwise
  fly forward 50 cm
  land
  LED color green
```

```
when space key pressed
  land

when e key pressed
  Emergency Stop

when green flag clicked
  forever loop
    if Tello query battery level < 20 then
      land
```

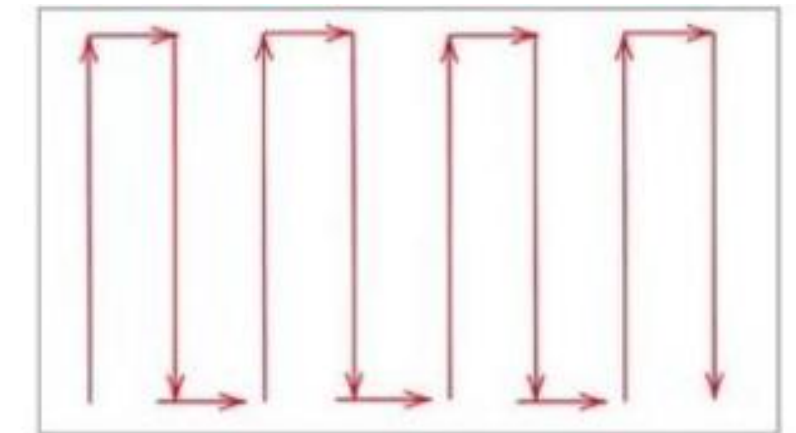


Activity : Programming a Square Flight Path

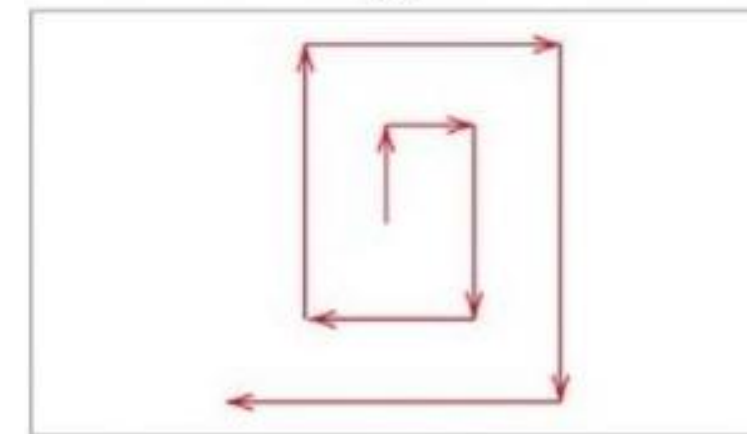
- Take Off
- Fly Forward
- Turn
- Repeat to form a square
- Land



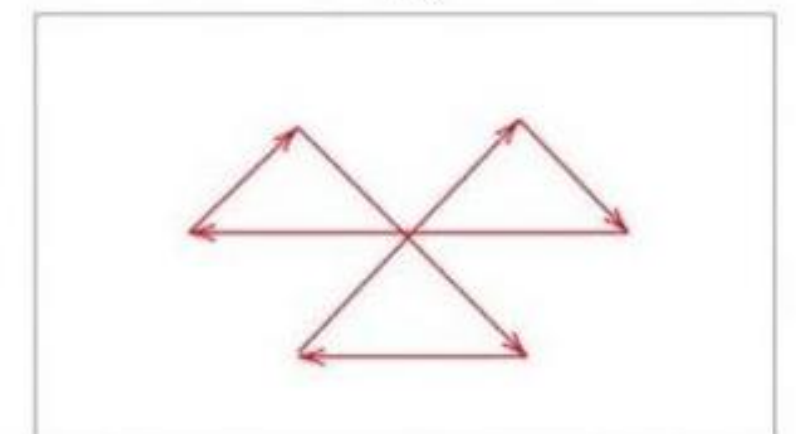
(a)



(b)



(c)



(d)

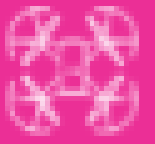
"Can we program our drone to fly a perfect square and land safely?"

Activity : Programming a Square Flight Path

- Start of the Mission
 - Always the TAKE OFF
 - Use Green Flag for event
- Keystrokes for other
 - Emergency Stop
 - Hover
 - Make Sound
 - What Else?

when  clicked

when  key pressed

 take off

 Emergency Stop

Activity : Programming a Square Flight Path

- Movement Control Functions
- Take Off function-> fly up to 50cm
- Distance accuracy is +-5cm
- Clockwise / CounterClockWise
- Fly backward or rotate 180degrees and fly forward?

 fly up 50 cm

 fly down 50 cm

 fly left 50 cm

 fly right 50 cm

 fly forward 50 cm

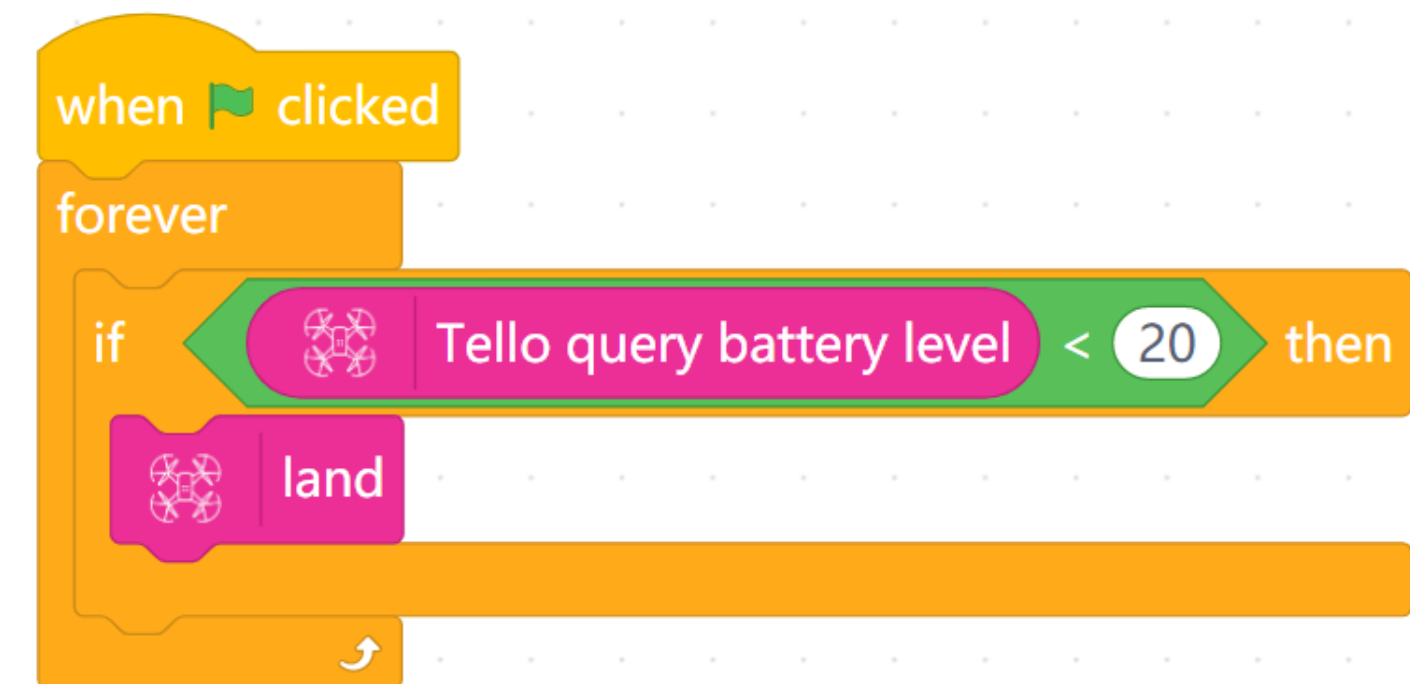
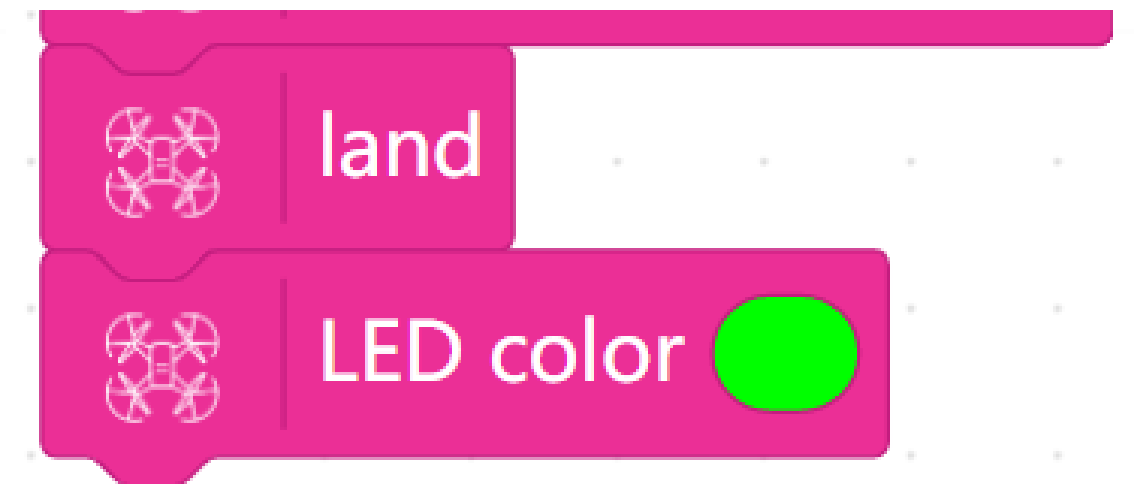
 fly backward 50 cm

 rotate 90 degree clockwise

 rotate 90 degree counter clockwise

Activity : Programming a Square Flight Path

- Landing is mandatory!
- Green LED for success
- Check if your pattern ends to obstacles
- Make a Low Battery Function



Activity : Programming a Square Flight Path

- Emergency Functions
 - Not flying the predicted path
 - Someone entered the fly zone
 - Emergency Stop -> Fall out of the sky



Test the Simple Flight Path Mission



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



Improvements and Limitations

- How do you think we can increase accuracy?
- How can we add more safety functions?
- How can we make it more reliable?
- Can we fly higher?
- Can we make some loop functions?



RECAP

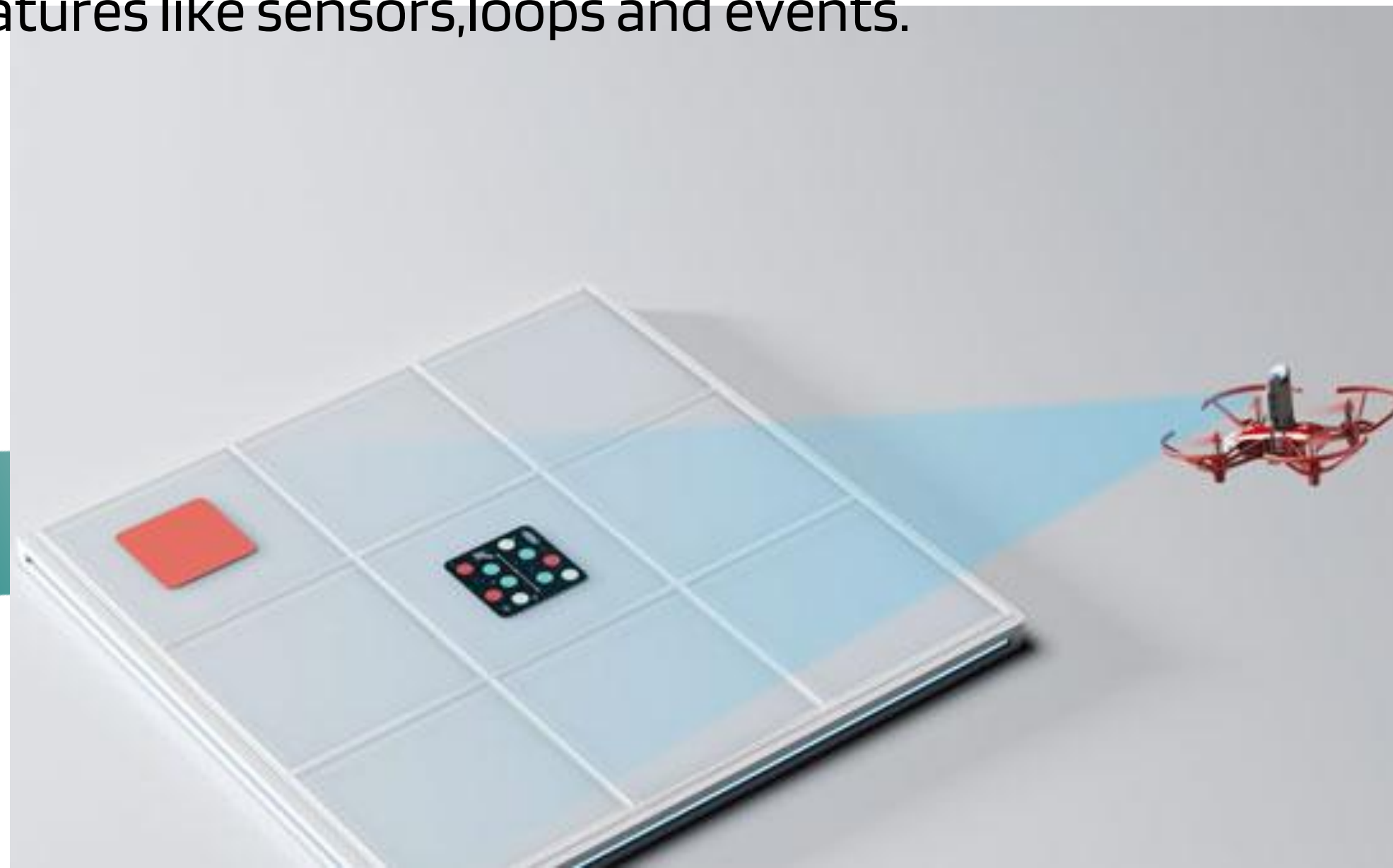
- What We Learned:
 - Programming Basics:
 - How to use block-based programming to control a drone.
 - Key blocks: take off, fly, turn, and land.
 - Drone Flight Path:
 - Programmed the drone to fly in a square pattern.
- Safety First:
 - Importance of clearing the flying area.
 - Maintaining a safe environment for everyone.
- Problem Solving:
 - Debugging and refining the program for better performance.



Next Step

- Next Steps:
 - Experiment with new shapes and flight patterns.
 - Explore more advanced programming features like sensors, loops and events.

What are your questions?



Additional Resources

Further Reading

<https://unece.org/environmental-monitoring>

<https://www.pem.tuc.gr/en/index.php?>

Videos

[Environmental Monitoring](#)

[Environmental Monitoring and IoT](#)

[Mr Copernicus: an introduction to Europe's environment monitoring programme](#)



Thank you for your
attention !



Co-funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.