Drone Programming

In Python

Python Library

We use "djitellopy", a Python library that provides an interface to the DJI Tello and Tello EDU drones using the official DJI Tello SDK. In simple terms, this package contains all you need for Tello drone.

Installation:

Install the package using the following command, i.e. run this command in the terminal: "pip install djitellopy"

```
pip install djitellopy
```

Connect to The Drone

The DJI Tello drone creates its own **Wi-Fi network**, which the computer connects to directly. Communication between the computer and the drone is done using the **DJI Tello SDK over UDP**.

Using the djitellopy library, the connection process is handled internally, and only a single function call is required: "tello.connect()"
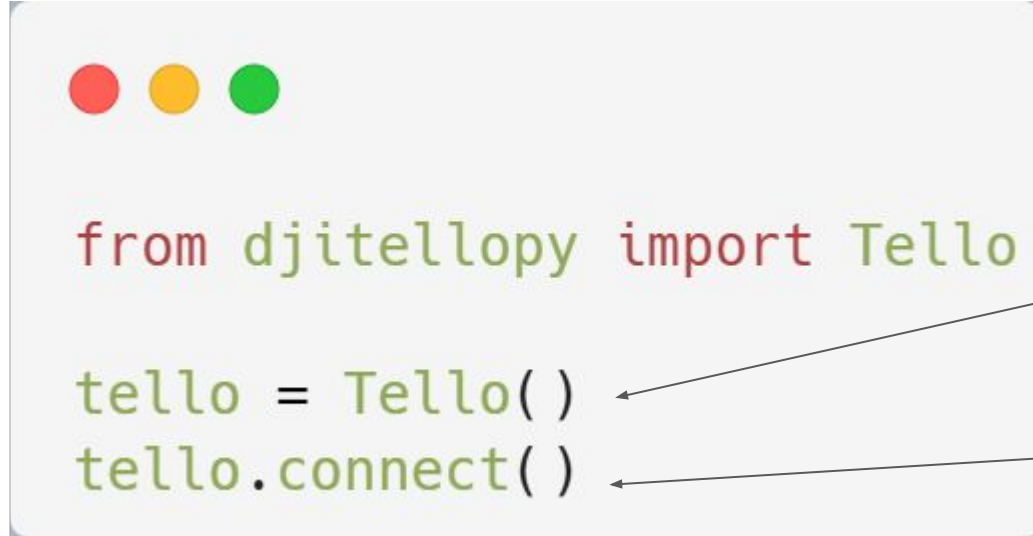
Connecting the Drone

```python
from djitellopy import Tello

tello = Tello()
tello.connect()
```

1. **Make sure device has connected to Drone Wifi Network (Tello-XXXXX)**

Connecting the Drone

```python
from djitellopy import Tello

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1. **Make sure device has connected to Drone Wifi Network (Tello-XXXXX)**

2. Create Drone Instance

3. Connect to Drone

Once connected, the drone is ready to receive control commands and send telemetry data.

Part 1: Taking Off and Landing

takeoff()

- Automatically lifts the drone off the ground and stabilizes it at a safe hovering height.

land()

- Safely brings the drone down and stops the motors once it reaches the ground.

Part 1: Taking Off and Landing - Example

```
from djitellopy import Tello

tello = Tello()
tello.connect()

tello.takeoff()
tello.land()
```

1. **Remember to create drone instance and connect!**

2. Remember to take off Drone before any command

3. Remember to land / shut off drone after some command

Part 2: Movement and Rotation

move_up(x)   : Moves the drone upward by x centimeters.

move_down(x)   : Moves the drone downward by x centimeters.

move_forward(x)   : Moves the drone forward by x centimeters.

move_back(x)   : Moves the drone backward by x centimeters.

Part 2: Movement and Rotation

rotate_clockwise(x)

- Rotates the drone x degrees to the right.

rotate_counter_clockwise(x)

- Rotates the drone x degrees to the left.

Rotation allows the drone to adjust its orientation before moving

Part 2: Movement and Rotation - Example

```python
tello.takeoff()

side_length = 50
angle = 120

for _ in range(3):
    tello.move_forward(side_length)
    tello.rotate_clockwise(angle)

tello.land()
```
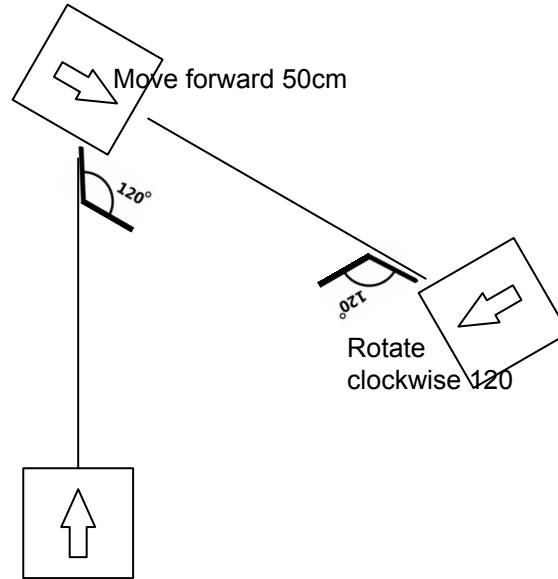
1. Take off Drone

2. Drone moves in Triangle shape

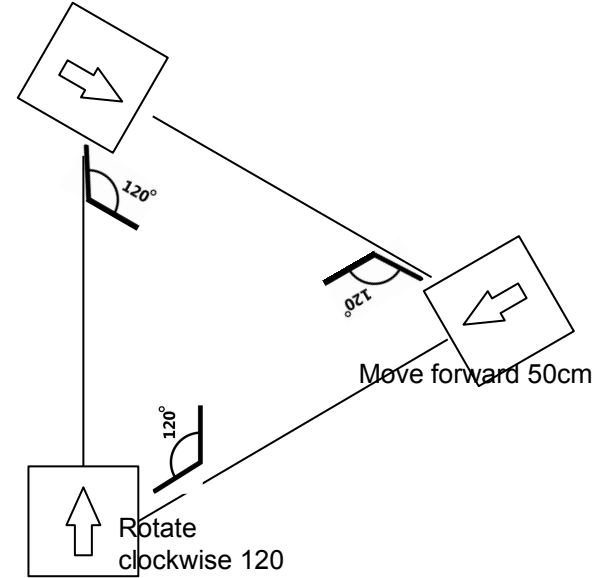3. Land Drone

Part 2: Movement and Rotation - Example
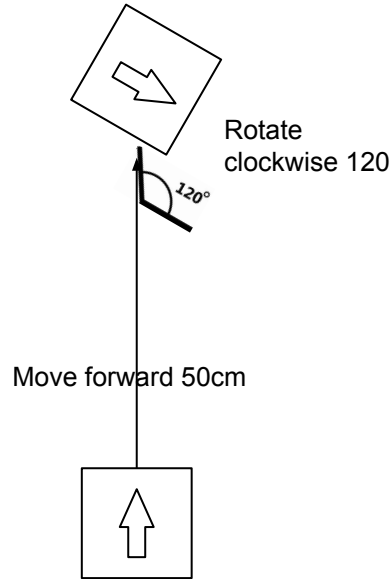
First Iteration

Second Iteration

Third Iteration

Part 3: Camera and Video Streaming

streamon()

- This command starts the video stream from the drone to the computer.

tello.streamoff()

- Stops the video stream safely when it is no longer needed.

You can also get the latest camera frame by:

frame = tello.get_frame_read().frame

Part 3: Camera and Video Streaming - Example

```python
tello = Tello()
tello.connect()

tello.streamon()
tello.takeoff()

reader = tello.get_frame_read()
while True:
    frame = reader.frame
    if frame is not None and frame.mean() >
10:    break

cv2.imwrite("tello_photo.jpg", frame)

tello.land()
tello.streamoff()
```

First of all, as usual, connect the drone

1. Enable Drone camera / stream

2a. Tello frame reader / receiver

2b. Ensure frame is not None or empty

3. Save frame as JPG

Part 3: Camera and Video Streaming

Troubleshoot AV error when reading frames:

av.error.OSError: [Errno 10014] Error number -10014 occurred: 'udp://@0.0.0.0:11111'

Reinstall AV package in python:

- pip uninstall av
- pip install "av<15"
- Try again…

What is cv2

cv2 (OpenCV) is…

- Python library for image and video processing
- Used for computer vision tasks
- Commonly used with cameras, cctv, drones, any vision devices/tasks

Installation:

Run this command **pip install opencv-python** in your terminal

Part 4: Advance CV Example

The goal of this task is to make the DJI Tello drone search for a human face autonomously using computer vision.

What the Drone Does

- Takes off and starts the camera stream
- Moves left and right to scan the environment
- Uses computer vision (CV) to analyze each camera frame
- Stops scanning once a human face is detected
- Lands safely after detection

Part 4: Advance CV

```python
face_cascade = cv2.CascadeClassifier(
    cv2.data.haarcascades +
)haarcascade_frontalface_default.xml"

while not found_face:
    frame = frame_read.frame
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # Detect faces
    faces = face_cascade.detectMultiScale(
        gray, scaleFactor=1.3, minNeighbors=5
    )

    if len(faces) > 0:
        print("Face detected!")
        found_face = True
        break

    if direction == "left":
        tello.move_left(30)
        direction = "right"
    else:
        tello.move_right(30)
        direction = "left"
```

1. Loads face detection model

2. Face detection loop

3a. Detect face in a frame

3b. Stop loop if face is found

4. Drone moves left and right

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Thank You