This document contains the homework 3 of the Robotics Lab class.

Fly your drone

The goal of this homework is to test your knowledge of PX4-Autopilot and develop a trajectory planner to fly your custom drone through a series of waypoints. The student is requested to address the following points and provide a detailed report of the employed methods. Additionally, a personal GitHub repository with all the developed code must be shared with the instructor. The report is due in one week from the homework release.

1. Build your custom multi-rotor UAV
   (a) Produce the necessary files to simulate the UAV correctly:
      - the folder containing the model description (`model.sdf`, `model.config`, meshes, materials, and whatever you deem necessary) to add into `PX4-Autopilot/Tools/simulation/gz/` folder;
      - the airframe file to add into `PX4-Autopilot/ROMFS/px4fmu_common/init.d-posix/airframes` with all the necessary parameters.

   (b) Fly your drone in *position flight mode* and plot the actuator outputs during your flight (look at the `ActuatorOutputs.msg` message)
2. Modify the *force_land* node. As it is currently implemented, when the altitude is equal to or above 20 m the land command is issued, but the pilot can manually retake the UAV control (before it lands) through the RC's control sticks, climb again over the altitude threshold, and re-trigger the automatic landing procedure
   (a) Modify the `force_land_node.cpp` file such that if the landing procedure is not completed and the pilot retakes control, even if the threshold is surpassed, nothing will happen. (**Hint:** use the uORB message `VehicleLandDetected.msg` to correctly implement this procedure).

   (b) To show the objective has been successfully reached, run a simulation, save a bag file with the following data and plot them:
      - the drone altitude during the flight, using the ENU reference frame (look at the `VehicleLocalPosition.msg` message);
      - the altitude manual control setpoint (look at the `ManualControlSetpoint.msg` message).
3. Design your trajectory planner using the offboard mode
   (a) Plan a trajectory with a minimum of 7 waypoints (free choice of path primitive), ensuring the UAV does not stop on the intermediate path waypoints during the trajectory execution (0 m/s only at the end). Do not forget to plan also the attitude setpoints.

   (b) Plot the following quantities:
      - the trajectory on the xy plane, and the altitude (look at the `VehicleLocalPosition.msg` message), and the yaw (look at the `VehicleAttitude.msg` message).
      - the UAV velocity and acceleration during the execution of the trajectory (look at the `VehicleLocalPosition.msg` message).