

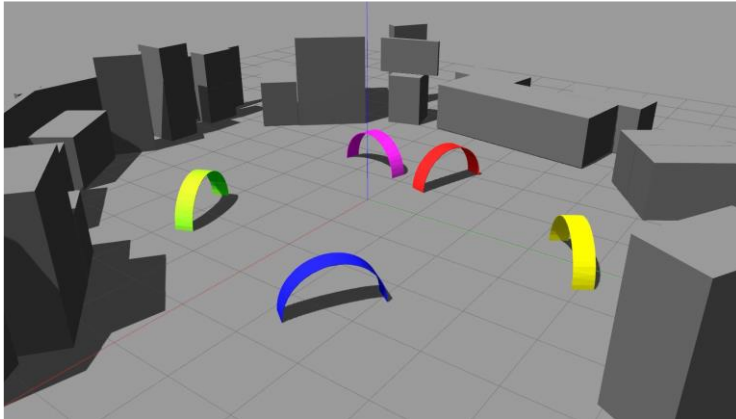
UAV Flying Project

Advanced Robotic and Autonomous Mobile Systems

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INTRODUCTION

The project aims at solving a task of flying UAV in a simulated environment under certain requirements. The UAV must fly autonomously through five gates of colors blue, green, purple, red and yellow in the respective order. Each of the gate is spawned only in its assigned region but at random positions in their region. It should not collide into any obstacles or with the ground during its flight. After completing the flight, it should return to its starting point.



SOLUTION

In this section one possible approach is discussed to solve the given task.

- Initial Approach:

To get a clear understanding of how the flight of UAV should be for this task a manual control was established wherein the bot could be operated using the assigned keys on the keyboard.

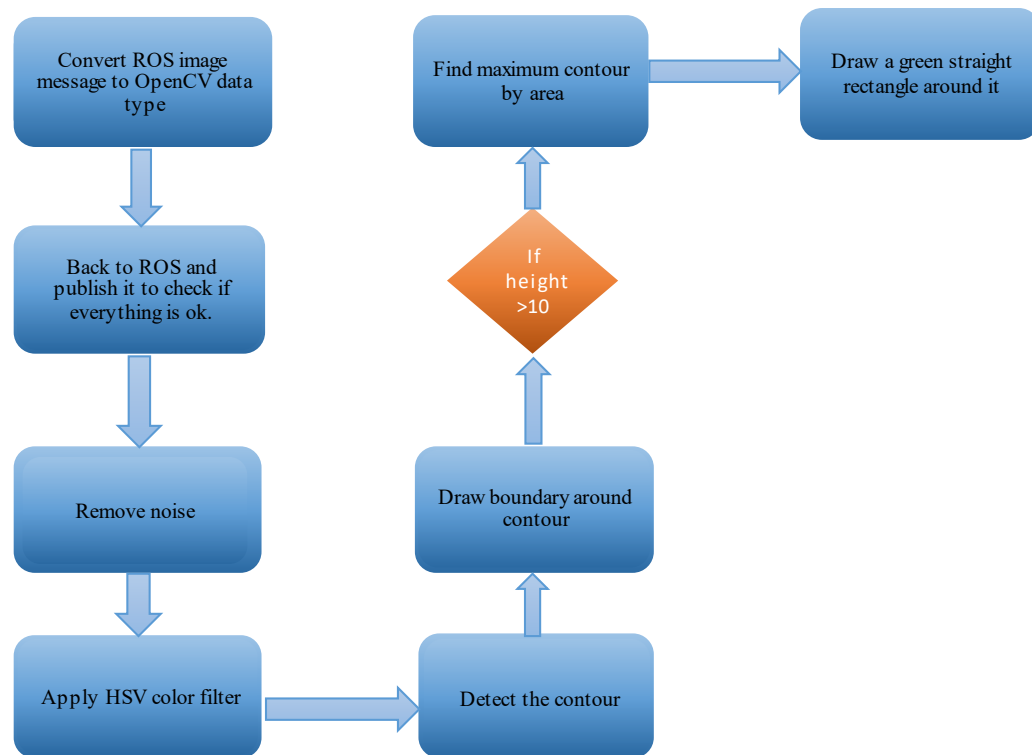
The keys are as follows:

A	Rotate anti-clockwise around yaw axis
D	Rotate clockwise around yaw axis
W	Move forward
S	Move backward
Q	Move left
E	Move right

- Gate detection:

For this part OpenCV library was used. The filter used is a HSV filter, for drawing contours a straight rectangle is used. If the detected contour height is more than 10 (to avoid detection of rotor blade of UAV while detecting blue gate) then a green straight rectangle is drawn. The maximum contour feature is useful to obtain height and width of the gate.

These are the steps involved in processing of images of gates and building contour around it.



- Flying through the gates:

The gate detection algorithm runs in the same script in which the UAV flight controls are programmed. The entire flight of the UAV is decided into 6 different steps which are called upon depending on the state of the UAV.

- Algorithm for flying through the gates:

1. (STEP 0) The UAV is given a command to take off to a fixed height which is almost equal to the half the height of gates.
2. (STEP 1) The UAV then searches for first gate that is **BLUE** and fly towards it.
3. (STEP 2) Then it tries it align itself to the gate.
4. (STEP 3) If the width to height ratio of gate in vision of UAV is less than the set value then it moves to next step (STEP 4).
5. In STEP 3 if the width to height ratio is not favorable then it goes to STEP 3.5 where the UAV tries to achieve the desired width to height ratio.
6. STEP 4 Now the UAV passes through the gate and a looping is performed.
7. After completing the loop, the UAV moves to STEP 0.5 where in if the gate is blocking the vision of UAV it tries to bring itself in the front of the gate.

8. The steps are then repeated for GREEN, PURPLE, RED and YELLOW gates in their respective order.
 9. Once the UAV has completed passing through all the gates it flies back to the home position and lands.
- Other Notes:
 1. The script detects one gate at a time and only when the UAV crosses the detected gate it detects next one.
 2. The camera resolution 320 x 240 is known thus the center of the image is known which can be used to guide the UAV.
 3. There is lidar check in front which avoids the UAV to hit the gates during the flight.
 - Looping:

For looping through the gates, the UAV after passing through the gate flies along a trajectory around the gates. The coordinates for this obtained on the position of UAV and gates.

CONCLUSION

The UAV can pass through the gates in the order and can also do looping. After completion of the flight the UAV returns to start point.