e-Yantra Robotics Competition - 2018

Theme and Implementation Analysis – Pollinator Bee

eYRC#1841

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Scope and Preparing the Arena

Q1 a. State the scope of the theme assigned to you. (5)

< Teams should briefly explain in their own words, the theme assigned. What in your opinion is the purpose of such an application? You may use figures / diagrams to support your answer.
Answer format: Text - limit: 100 words>

The theme assigned to us is Pollinator Bee. We recreate the activity of pollination performed by Bees albeit in this case we use a drone which acts like the bee and LEDs that act like the bright colours of a flower to attract the bee .

By using the techniques of Image processing,Control Systems and Drone Control,we achieve our objective of mimicking the activity of a bee in nature.

By using the above concepts learnt,we can build drones that can be used for disaster management,a drone can enable to detect survivors and go places where a firefighter cannot reach or is too dangerous for him/her to go.

b. **Attach the Final Arena Images. (10)**

< Prepare the arena according to the steps given in the *Arena* section in Rulebook. Please follow the arena configuration shown in figure 6 of the rulebook.
Place the Plants and the Beehive in their respective locations as per the rulebook and take 3 photos of the completed arena from different angles such that the entire arena is clearly visible in the photos.
The three image files should be uploaded along with this document.>


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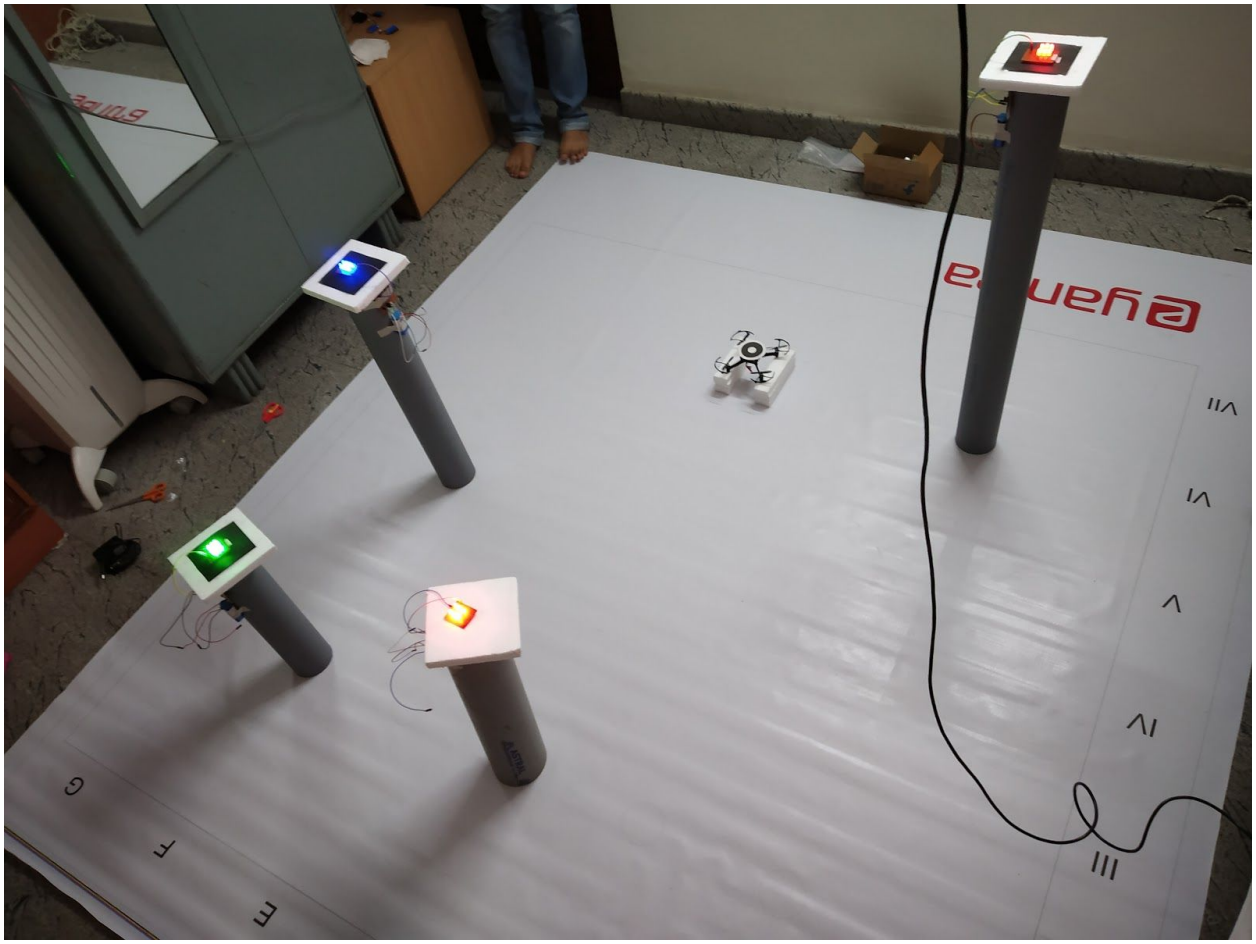


Testing your knowledge (theme analysis and rulebook-related)

Q2. How will you ensure that while tuning the PID value, Drone will not crash? (5)

< Explain the method (“juggad”) and/or code you will used to tune the PID without crashing. Attach the picture of same.>

We tied the frame of the drone to the end of a light but strong string, and weighed down the other end. This ensured that the drone could fly freely, and also not crash if something went wrong. Since we had an approximate value of pid from the drone app, we did not have to implement software thresholds explicitly for this task.

One more safety factor we implemented was that when the code is stopped, the drone disarms and lands immediately.

Q3. How will you detect the LEDs lighting up using image processing? You may use your pseudo code to explain your approach. (5)

< Explain the algorithm to detect the LEDs lighting up. Will it check the LEDs' status after/during a certain event or continuously? >

The ros_bridge package is an API which enables us to use ros package using Python. CV bridge acts as an interconnect between input ROS source to openCV for image processing.

First, we obtain the image from the camera using imshow function and store it in a variable called "image". We can convert this image to an hsv image using "bgr2hsv" function. Then we

define the lower and upper boundaries for the hue, saturation and intensity through arrays to generate masks for each colour. We “bitwise-and” the original image with the mask to generate regions of interest corresponding to the red, green and blue colours emitted by the LEDs.
After this we convert the obtained image (may correspond to any one of the 3 colours) to grayscale using “bgr2gray” function and perform binary thresholding on the same.
We use the findContours function to detect the precise edges of the LEDs which are lighting up. This can be precisely performed by adjusting the boundary values which were defined in the array. We must use the attributes for contours as per requirements. For example for our code we use the “CHAIN_APPROX_SIMPLE” method to draw contours.
Finally, we use the “drawContours” function to draw the outlines around the region of led lighting detected. Here we ensure that the detected region is lighted LEDs by checking the area of the drawn contours lies between a predefined range and ensure that there’s no errors in detection.

Q5. Let us consider a scenario: (5)

The Pollinator Bee has reached a desired waypoint, but the LEDs at the waypoint have not lit up.

What will happen according to your algorithm (Consider the theme rules specified in the rulebook)?
< Explain in detail how your algorithms will tackle this case. >

The drone will hover over the flower for a good amount of time, so that ample time is provided for the short to occur. In case it does not happen, the drone can be made to go back to waypoints that have not been lighted yet, after visiting all other waypoints. This mechanism/ algorithm ensures or double checks for the success case, hence decreasing chances of a fail case.

Q6. What will be your strategy to earn maximum points in a run? (5)
< Explain various cases you can think of and their possible outcomes. Read and understand the Judging and Scoring Parameters. >

1) To finish the task as fast as possible, we need to have very efficient PID tuned values.
2) To ensure that maximum number of flowers are successfully pollinated, we need to use an algorithm that double checks, and tries to pollinate the flowers that are yet to be pollinated.
3) To ensure that the drone lands on the beehive, the PID need to tuned to perfection.
4) To procure more points in the creativity criteria, we need to be innovative and efficient with the designs.

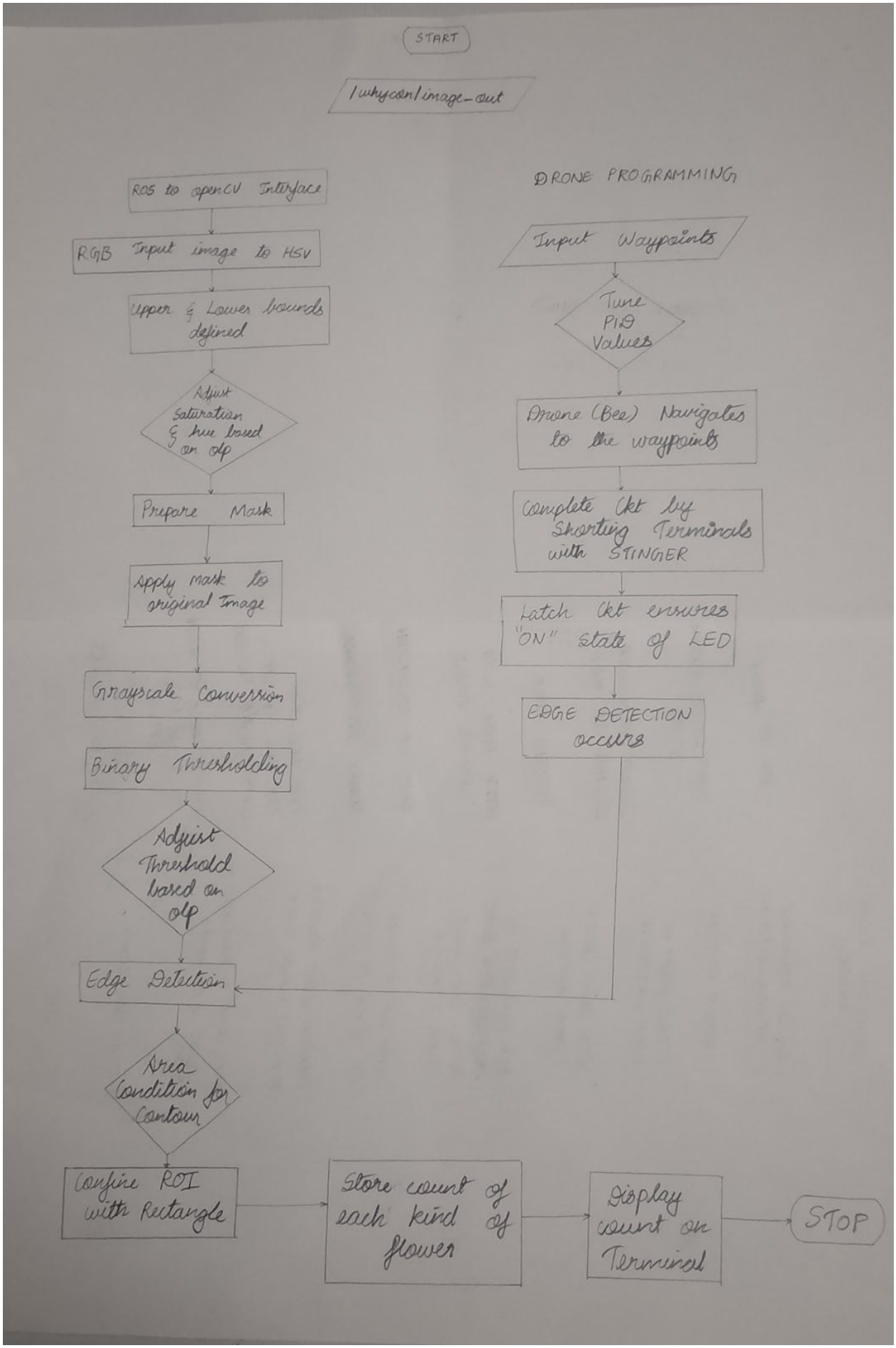
5) We also need to stay within the camera frame, so as to not incur penalty for reposition. The plant has to be stuck firmly so that it does not fall.

Algorithm Analysis

Q5. Draw a flowchart illustrating the algorithm you propose to use for theme implementation.

(10)

< The flowchart should elaborate on every possible function that you will be using for completing all the tasks in the assigned theme.
Follow the standard pictorial representation used to draw the flowchart. >


START
/whycon/image_out
ROS to openCV Interface
RGB Input image to HSV
Upper & Lower bounds defined
Adjust Saturation & hue based on o/p
Prepare Mask
Apply mask to original Image
Grayscale Conversion
Binary Thresholding
Adjust Threshold based on o/p
Edge Detection
Area Condition for Contour
Confine ROI with Rectangle
Store count of each kind of flower
Display count on Terminal
STOP
DRONE PROGRAMMING
Input Waypoints
Tune PID Values
Drone (Bee) Navigates to the waypoints
Complete Ckt by Shorting Terminals with STINGER
Latch Ckt ensures "ON" state of LED
EDGE DETECTION occurs

Challenges

Q15. What are the major challenges that you can anticipate in addressing this theme and how do you propose to tackle them? (5)

The challenges that we might face:

1. Perfect tuning of PID.
2. Drone stabilization over the flower.
3. Accurate detection of flower by the camera in the presence of varying lighting conditions.
4. Contact between petal and drone, the set of actions to be performed when the drone fails to contact the petal.

How we plan to address:

1. Try repeatedly to achieve perfect drone stability by using plot juggler and pid tuning GUI.
2. Achieve perfect tuning of PID for the drone.
3. Use a room with minimal natural lighting and use only fixed light sources.
4. Try different arrangements of petals, and use the one that gives the best results with the stinger. Use algorithms that double check, so that the flower is made contact with at least once.