e-Yantra Robotics Competition - 2018

Theme and Implementation Analysis – Pollinator Bee

<1027>

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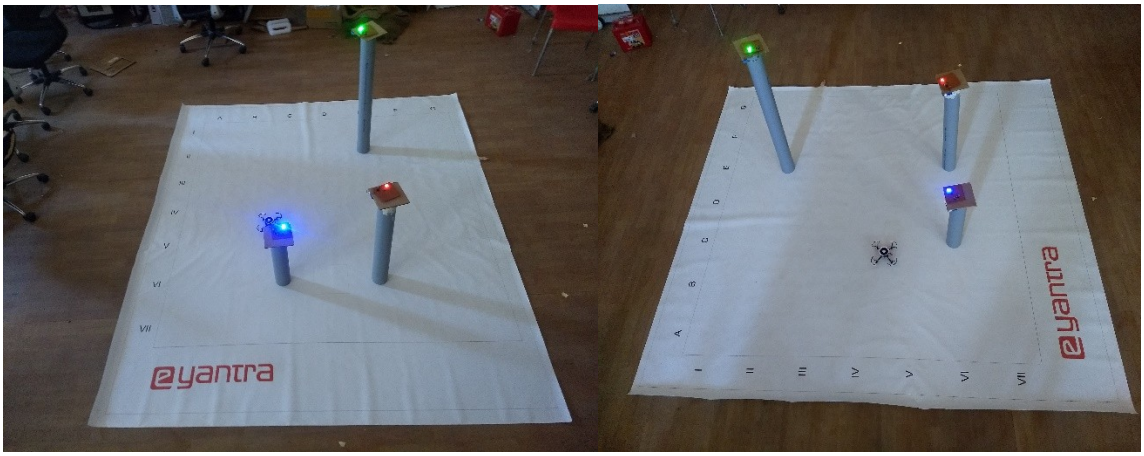
Scope and Preparing the Arena

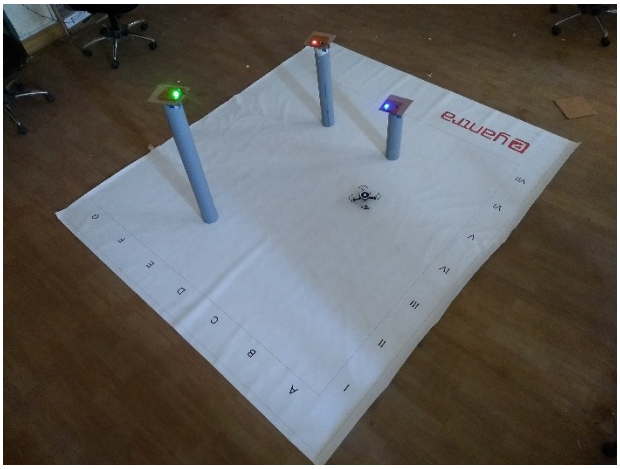
Q1 a. State the scope of the theme assigned to you.
(5)

Indoor agriculture is one of the application of our theme. Currently we are given one USB camera which only covers small part of the room. In outside world, if the same theme is to be applied we need more than USB camera, like GPS or drone with built in camera. In real world most of the plants are unable to attract the birds towards them, so these plants won't get pollinated and they won't be able to produce flowers and fruits and eventually their species will go extinct. Our theme would be helpful in solving this issue.

Another application would be to deliver food to tables in restaurant, if more robust drone is used, like if it can handle more weight and also this method can be used to sow seeds on a very large agricultural field. This process is a time consuming process to do it by hand but with drone it can done very fast.

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





The plants are placed inside the circles given on the arena. We have not built the beehive and petals yet as the problem didn't tell us to build them. This is not our final arena and plants, and we are going to modify it after this task.

Testing your knowledge (theme analysis and rulebook-related)

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

The first step we used to do is to disarm the drone as fast as possible when it went slightly out of camera's view or out of arena. Then after disarming, the drone would fall, so we thought about it and used one guy to disarm and two members in our team to do the following,

1. The two members would be standing opposite to each other across the arena.

2. Both of them were holding a big cardboard in their hand. They used to catch the drone after disarming it.

3. We started everything with constant P and we didn't give very high values for constant P.

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

Pseudocode:

redimage=image

Explanation= the image here is the image output we are getting from usb_cam_image_rect topic. Which have been converted to open cv frame to

do processing on it.Here we are detecting red led but can be done to any color.

```
param1=[50,50,140]
param2=[70,65,165]
lower=np.array(param1)
upper=np.array(param2)
```

explanation: Using cv2.imshow we checked the image obtained in ‘red’(the next line in code’),we note down the lower and higher pixel value of red color we were obtaining then stored it in param1 and param2.

```
red=cv2.medianBlur(redimage,13)
```

explanation:we were not getting the perfect red pixel it had more white in it,to rectify this we used medianBlur to get pixel with more red content and used this image for storing lower and higher value of the pixels in param1 and param 2.

```
mask=cv2.inRange(red,lower,upper)
```

explanation: since mask shows only the pixels within the given range we used this to show only pixels of red led.

```
rbc1,self.redcontours, hierarchy1 = cv2.findContours(mask, cv2.RETR_TREE,cv2.CHAIN_APPROX_SIMPLE)
```

explanation: after masking we got an image showing only pixels around red led. We used the above code to see whether all these pixels are grouped together or whether there is gap between the found pixels or whether we are detecting something else other than red colored leds.

We blurred the image in such a way that we would get only red led in the mask, so as there was only one plant with red led the length of self.redcontours was giving value as 1, This would confirm that the red plant has been pollinated and the drone can go to the next plant

```
Mr=cv2.moments(self.redcontours[-1])
redcx=int(Mr['m10']/Mr['m00'])
redcy=int(Mr['m01']/Mr['m00'])
```

cv2.rectangle(image2,(redcx-12,redcy-8),(redcx+12,redcy+8),(0,0,255),1)

explanation: The task asked us to draw a rectangle around the detected led's. For this we used moments Because our logic was as follows

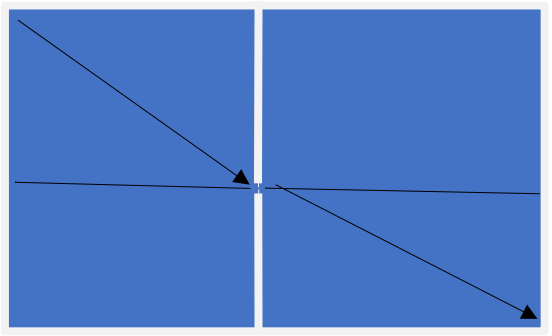
1.moment will give the centroid of the detected contour and this centroid will give x and y value of the centroid

2.since in rectangle lengths and breadth are not equal,using centroid coordinates ,if two unequal values are subtracted from x and y ,it would give top left point of rectangle,and if the same two unequal value are added to x and y it would give bottom right point and we used this point to draw rectangle using cv2.rectangle

self.image_pub.publish(self.ros_bridge.cv2_to_imgmsg(image2,'bgr8'))

we used this to convert from open cv frame to whycon frame. Our code would be detecting the color continuously,currently if the led is not on or detected it will show zero division error as contour length would be zero and in moments divison will by zero.

X-12,Y-8



X+12,Y+8

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)?

The LEDs havent been lit up because of the following reasons

1.Not enough battery

2. Bee stinger hasn't touched the plant petal.

We haven't written the code for visiting of different waypoint/task 4. According to the current logic we are thinking of, the drone will stay at the current waypoint only, because according to our logic the drone will move to next waypoint only after the code returns the value of the length of contours as 1.since we get 500 points for each plant pollinated, we will wait till it gets pollinated.

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. We will try to pollinate all the flowers irrespective of the time. We will concentrate more on finishing the task. The point we get for each flower pollinated in 500, so if we pollinate all the flowers irrespective of time we will get 2500 points for that, if we complete the task at 10 minutes we will only lose 600 points but net gain is 1900.

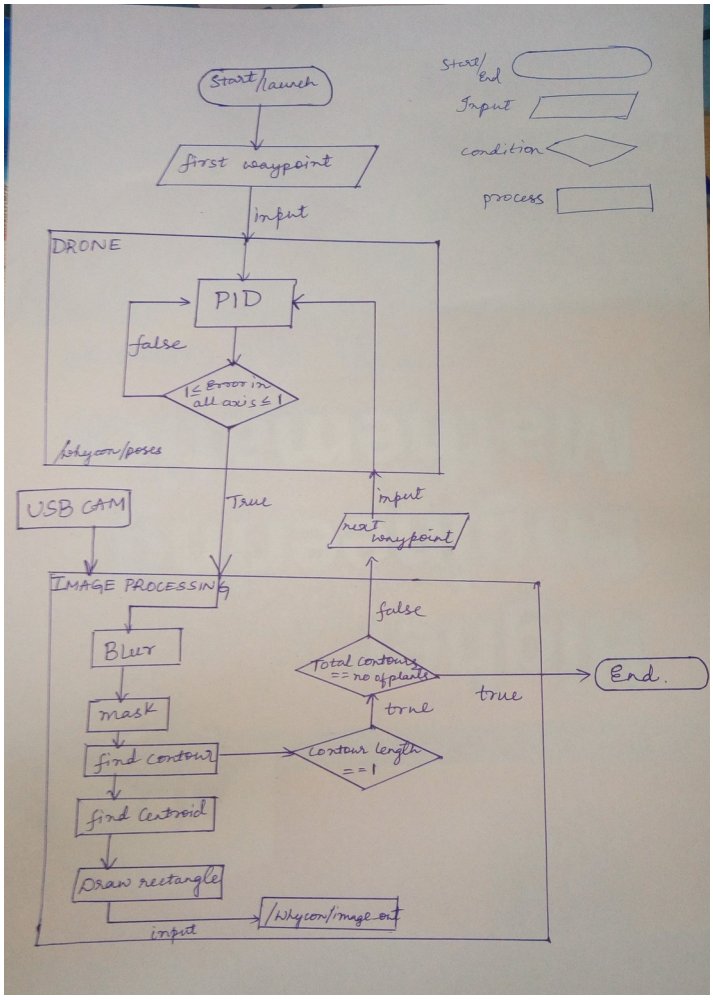
2. Care will be taken on the creativity part. This is because the creativity and the task completion is in our hand and we will try to excel in those first

3. If time remains in preparation then the concentration will be on the speed.

Algorithm Analysis

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

(10)



Challenges

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

1. Challenge 1: PID tuning and safety of the drone in task 3, the drone would go out of arena to stop it we were disarming it as fast as possible and were catching it using a cardboard in hand and not letting in fall on land or crash a wall

2. Challenge 2: drone going out of arena, we haven't written a code to solve this but we are thinking of it like using maximum error in roll and pitch axis we can alter its roll and pitch value so that the error in pitch and roll is less than maximum error.

3. Challenge 3: led detection in all lighting condition: the pixel value varies in different lighting condition, the tip u have mentioned in rule book about using aluminum foil, we haven't tried that, we will use that and see whether it will give same pixel values all the time

4. Challenge 4: we may find a challenge in interaction between bee stinger and the petal, we haven't thought about it yet.

5. Challenge 5: battery problem, we need to search for good batteries for the drone and LED.

6. Challenge 6: crashing of drone with the plant, while moving from one plant to another plant of different heights it might crash, to tackle this problem we are thinking of adding additional co-ordinate higher than all the coordinates, only after reaching this height it can go to next plant.