e-Yantra Robotics Competition - 2017

Theme and Implementation Analysis – Planter Bot

<Team ID>

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Scope and Preparing the Arena

Q1. a. State the scope of the theme assigned to you.

(5)

In India agriculture and its allied sectors contributes about 13.7% of GDP (in 2013) and it requires about 50% workforce. But as new initiatives for "make in India" and jobs are being generated in developing urban sectors the agriculture sector is facing a lack of manpower. To solve these upcoming problems many look upon robots as a possible solution. Our theme "Planter Bot" is supposed to be designed in such a way that the robot plants the saplings according to the need of farmers, thereby reducing the workforce required to do this task.

b. Upload the Final Arena Images.

(20)

< Prepare the arena according to the steps given in Section 3: Arena, of the Rulebook. Please follow the arena configuration shown in “Figure 1: Arena Design” and “Figure 4: Arena Design with Dimensions” of the rulebook.

Configuration for Zone Indicators and Color Markers associated with them are as per following Table:

Zone Indicator Number	Cell number for Zone Indicator	Color Marker Type	Number of Color Markers
1	N3	Red Circle	3
2	F7	Green Triangle	4
3	O11	Red Square	1
4	E16	Blue Square	2

In addition to this, place a Zone Indicator at Cell number J16. This has no Color Markers associated. Refer to Section 2: Theme Description and Section 6: Theme Rules of Rulebook for more information about this.

Take 4 photos of the completed arena from different angles such that the entire arena along with its components such as Terrains, Zone Indicators, Cells, etc., is clearly visible in the photos.

Answer Format: The four image files should be uploaded as **.jpg** along with this document as per instructions in Read Me for Task 3. >

Building Modules

Q2. Identify the major components required for designing the robotic system for the theme assigned to you.

(5)

Electronic Systems
1. Raspberry pi 3
2. Pi cam
3. L298N motor driver
4. Power sources (Batteries)
5. LEDs (RGB)

Mechanical Systems
1. Encoder Motors
2. Wheels
3. Chassis
4. Clamps
5. Stand to mount pi cam

Power Management

Q3. a. Explain the power management system required for a robot in general and for the theme assigned to you in particular.

(5)

For designing "Planter bot" we need 2 power sources, one for running Rpi3 (5V 2A) and the other for driving the motors (12V 2A). The preferable mode of power supply for us is batteries.

Rpi3 requires a lot of power and draws upto 1A to stay awake. In order to process all the given information the Rpi3 module draws 2A current.

The power required to drive the motor depends on the motor ratings, in other words the motor is chosen according to the task requirements. In our task the motor should be capable of moving a robot of 1-2kgs with considerable speed. Hence the requirement for this is 12-15V and a current of 2A.

b. Can there be a single power supply for your robot? - Yes/No/Don't know. Please elaborate/justify your answer choice.

(5)

YES, a single power source is possible in this case provided the capacity of the battery is high.

The only advantage is the space and weight reduces but at high cost and hence for planter bot this is not recommended. Raspberry pi requires a very stable power supply thus it's not

preferable to use a common source for Rpi3 and the motors. Moreover a voltage regulator is also required to do this job.

Design Analysis

Q4. Teams have to design a robot which traverses an arena following a given path and simulate planting by overlaying image in GUI.

a. How will your robot traverse a field represented by the Arena given in the rulebook?

(5)

The picam will be clamped to the traversing robot at a specific angle and will continuously be sending the information of the path to be traversed in RGB form. This RGB information will be from an array of collinear (horizontal) points. The information is continuously processed and several conditions are specified for Rpi3. If the midpoint is black and the rest are white the robot is made to traverse in a straight path. If the midpoint is white and all the rest are black then the bot traverses through the inverted plane. If all the points are black then the bot stops and takes a photo of the zone. If some of the points to the left/right are black then appropriately the bot turns left/right. If white color is detected across all the collinear points then robot is instructed to stop.

b. If you were to implement this theme in the real-world scenario, what would be the actuators you will employee? Explain their purpose.

(5)

The actuators required will be,

'Geared DC motors' to move the bot to the required destination. Using geared motors we can easily control the speed of the bot.

'Servo motors and step motors' to design a robotic arm which helps to plant the saplings. Using servo and step motors we can control the robotic arm easily.

Environment Sensing

Q5. a. Explain how you will use the PiCam to decide the course of traversal.

(5)

Pi cam is mounted at a specific angle and height such that the continuous video feed of the path in front of the bot is given to the Raspberry Pi to process and direct further action. The video is analyzed frame to frame and bot is directed as required.

b. Would the webcam be a better choice of camera over the Pi Cam? Explain.

(5)

Using Pi cam would be a better option as it can be easily interfaced with the Raspberry Pi. Also that Pi cam has better resolution than most of the webcams available at the given budget. Pi cam can be mounted easily into any customized stand. Pi cam is also cost effective. Only problem in using Pi cam is that it is very fragile and requires a proper casing.

c. What other sensors will the robot require to complete its task successfully?

(5)

No other sensor except Pi cam is required to complete the task

Testing your knowledge (Theme Analysis and Rulebook-related)

Q6. a. If a team has an overlay similar to one shown in the Figure 1, how many points will you score for the overlay in total. Specify score for accuracy, penalty if any and total. Elaborate on penalty if any - why it will be applicable?

(5)

Note: The team has selected the correct seedling image upon detection of Color Marker and there are three such Color Markers at the Zone Indicator.

Figure 1: Overlay Example

The formula used to score the run is Total Score = (600 - T) + (ZD*100) + (CMD*75) + (TT*100) + (IPP*200) + (O*25) + (B) - (P*50) where P is the number of penalties

In the above overlay image there are 2 partially overlaid images. Thus that corresponds to 2 penalties. Only the above overlay image is scored. Hence 100 marks will be deducted from the final score.

b. Name the different Terrains in the Arena.

(3)

1: Hill side road
2: Berms
3: Cliff roads
4: Inverted plains

c. How many possible unique Color Markers can be made in this theme?

(3)

9

d. If there are 3 Blue Triangle Color Markers placed in front of a Zone Indicator, how will you indicate this via hardware only?

(3)

When 3 blue triangles are detected in a zone indicator it is indicated by blinking the Blue LED on the bot thrice at an interval of 1s between each blink.

e. What are the different conditions that indicate end of a run?

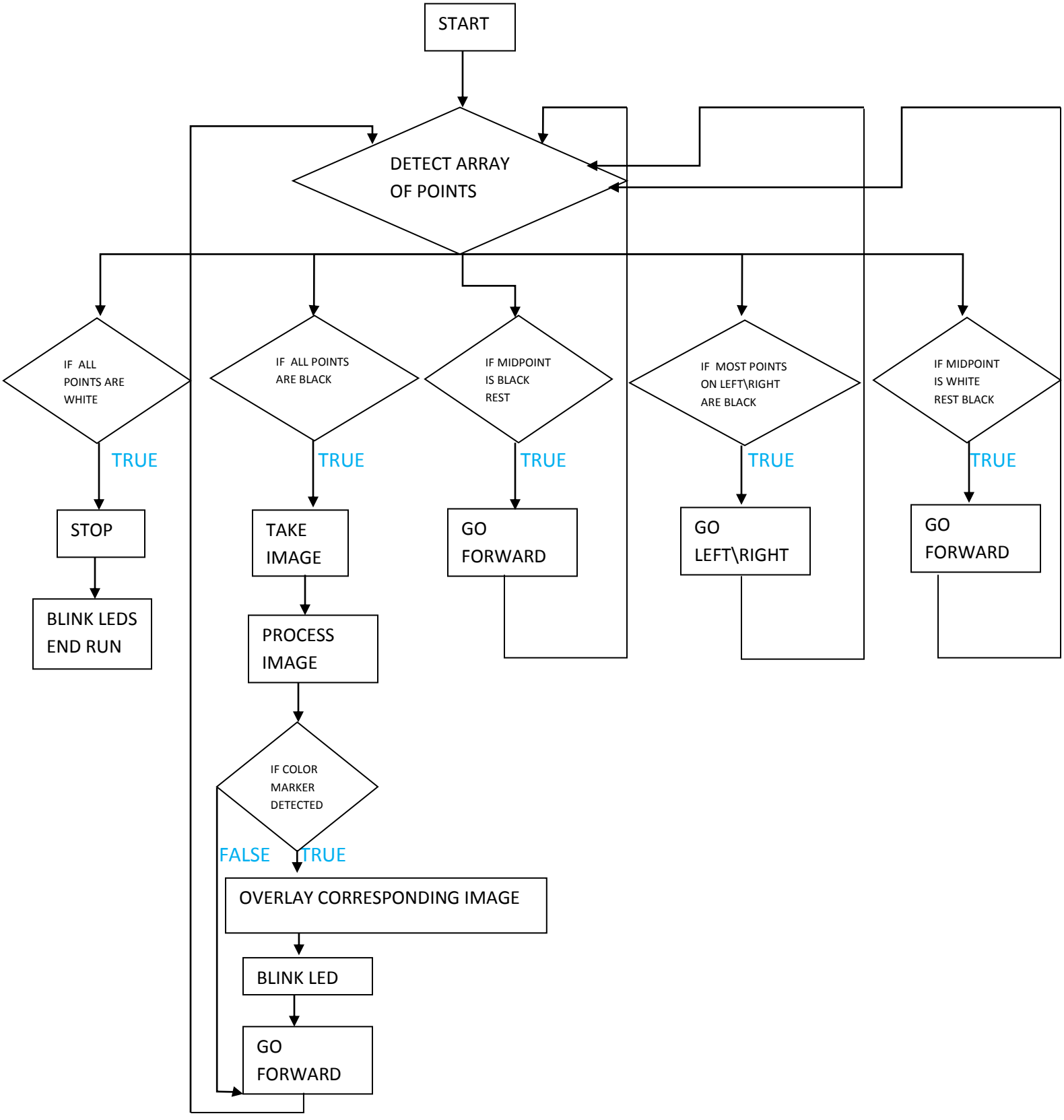
(3)

Condition 1: The bot should stop at the shed
Condition 2: The LED on the bot should blink corresponding colors of color markers detected in plantation zones from first to last zone respectively

Algorithm Analysis

Q7. Draw a flowchart illustrating the algorithm you propose to use for theme implementation.

(10)


START
DETECT ARRAY OF POINTS
IF ALL POINTS ARE WHITE
IF ALL POINTS ARE BLACK
IF MIDPOINT IS BLACK REST
IF MOST POINTS ON LEFT\RIGHT ARE BLACK
IF MIDPOINT IS WHITE REST BLACK
TRUE
TRUE
TRUE
TRUE
TRUE
STOP
BLINK LEDS END RUN
TAKE IMAGE
PROCESS IMAGE
IF COLOR MARKER DETECTED
FALSE
TRUE
OVERLAY CORRESPONDING IMAGE
BLINK LED
GO FORWARD
GO FORWARD
GO LEFT\RIGHT
GO FORWARD

Challenges

Q8. What are the major challenges that you can anticipate in addressing this theme and how do you propose to tackle them?

(8)

1. Perfection in line traversing at significant speed of the bot
2. Reduction of unwanted contours in the photograph taken by pi cam
3. Continuous perfection in detecting black and white colors in path traversal
4. Simplification in circuitry and compactness of the bot