e-Yantra Robotics Competition - 2019-20

Implementation Analysis: Construct-O-Bot

<Write Your Team ID>

Team leader name	
College	
Email	
Date	

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

(5)

< Team should briefly explain in their own words the theme assigned. What in your opinion is the purpose of such an application?
Answer format: Text, Word - limit: 100 words>

Due to its unique geographical and climatic conditions,India is one of the most disaster prone country of the globe.

When the disasters strikes,the aftermath is atrocious.During these times governments,NGOs and other private organisations together try to help the people residing in that disaster affected areas.One of the major activities include reconstruction of damaged structures.These activities are labour intensive and involves high risks.To avoid these risks,an autonomous path following robot can be used which can help people in bringing the construction materials from the warehouses to the reconstruction sites by traversing the challenging terrains where the risk is involved.Not only does it reduce the risks but also finishes the rehabilitation task in the shortest time possible which is the need of the hour.

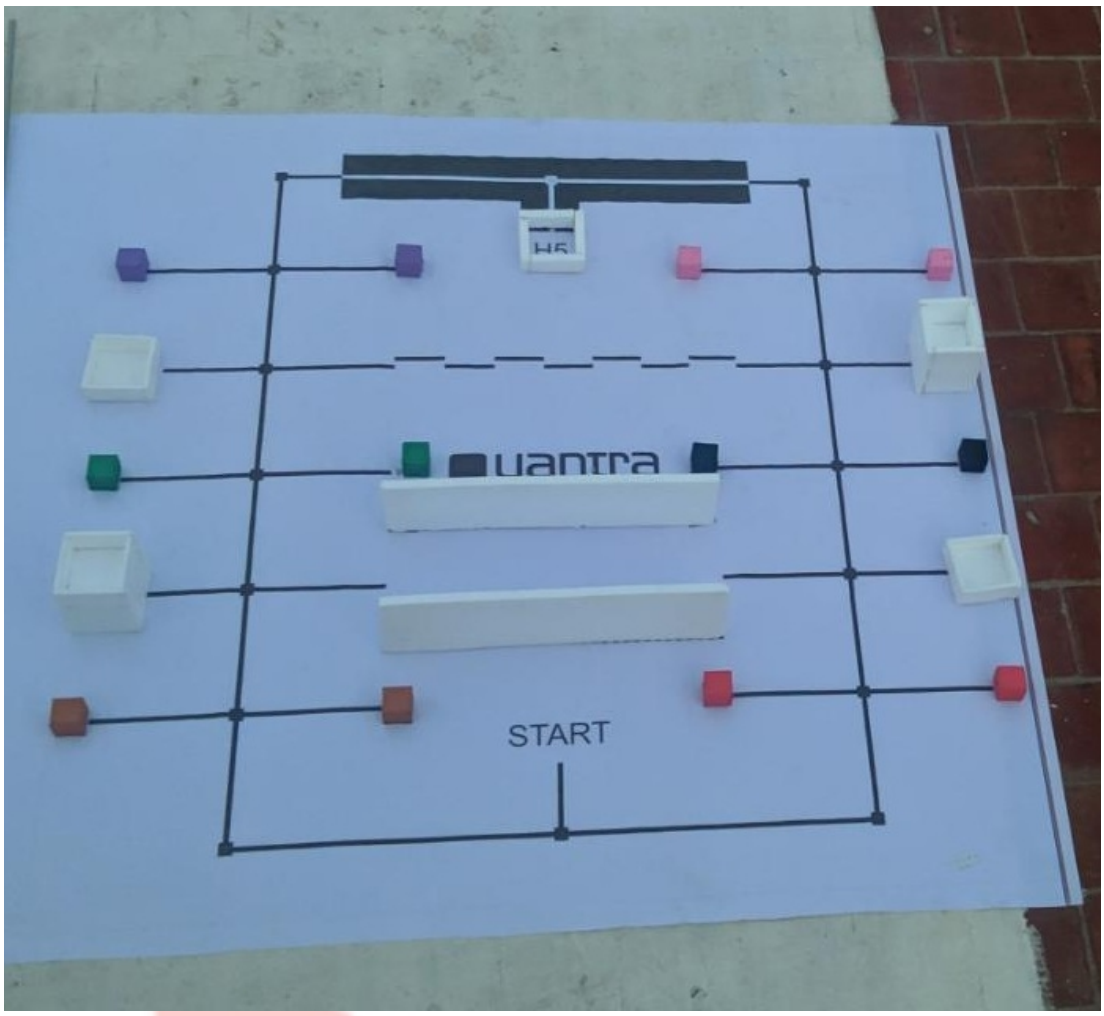
b. Upload the Final Arena Images as per configuration given in the rulebook.

(5)

< Prepare the arena according to the steps given in Section 3: Arena, of the Rulebook. Your final arena should look like as shown in Figure 6 of Rulebook.

Take photofrom the top view of the complete arena such that the entire arena along with its components such as Construction Materials, Walls, low-rise House and high-rise House are clearly visible in the photos.

Answer Format: The one image file should be insertedin this document as **.jpg.>**



c. Team have to design a robot to solve the problem as mentioned in the rulebook. Attach the final robot design in the answer. Why have you come up with such a design? (20)

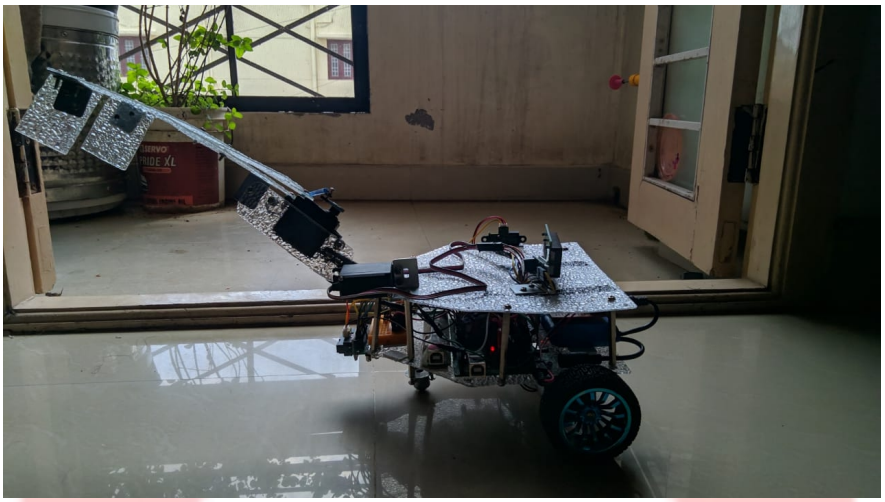
<Attach picture from different angle of your designed robot. You can mark the component placement on the top of picture. Also mention the strategy of this design (for explanation you can use some animation or hand drawn photos)along with advantages and disadvantages in comparison to other designs.

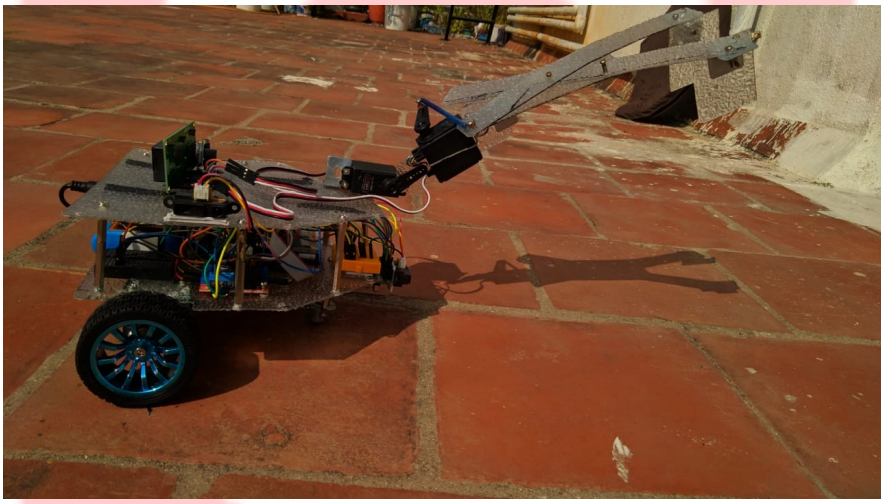
Note: Teams with "good" design based on the functionality and aesthetics will be given more marks.

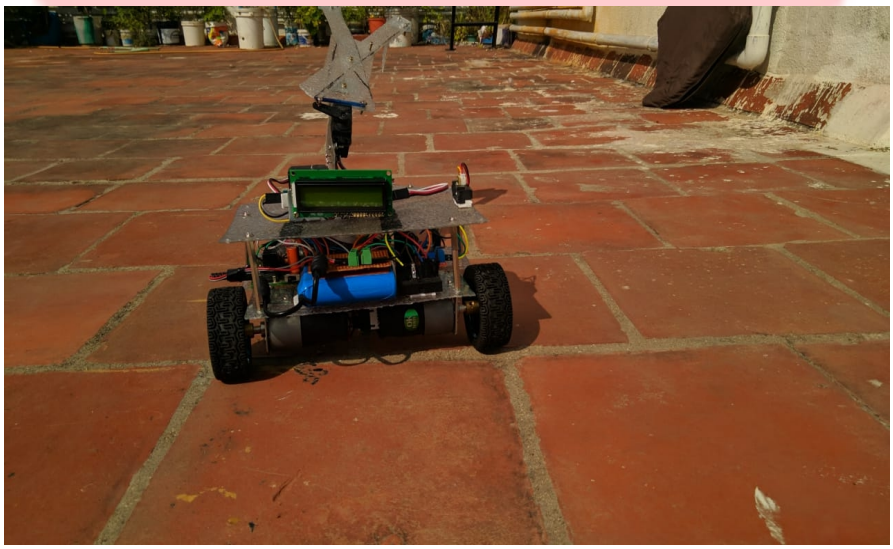
You can use bullet points like:

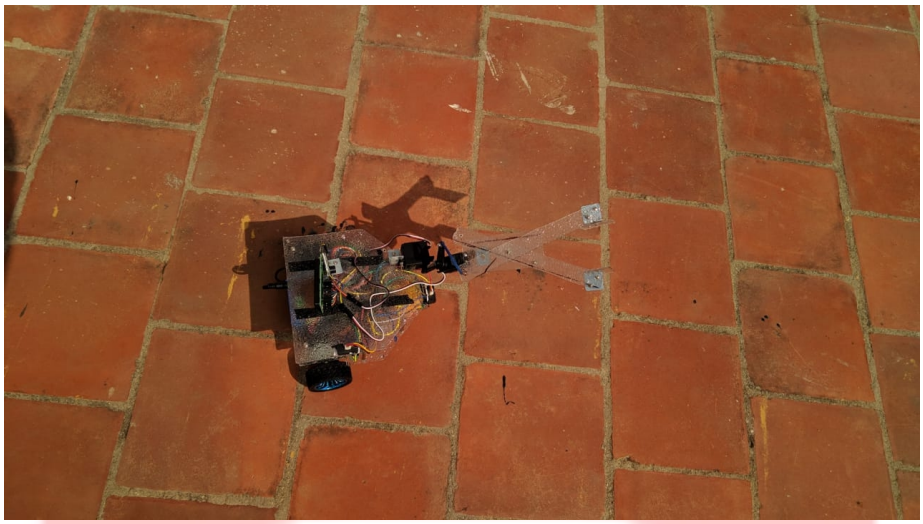
1. Sensor Placement
2. Arm Mechanism
3. etc.

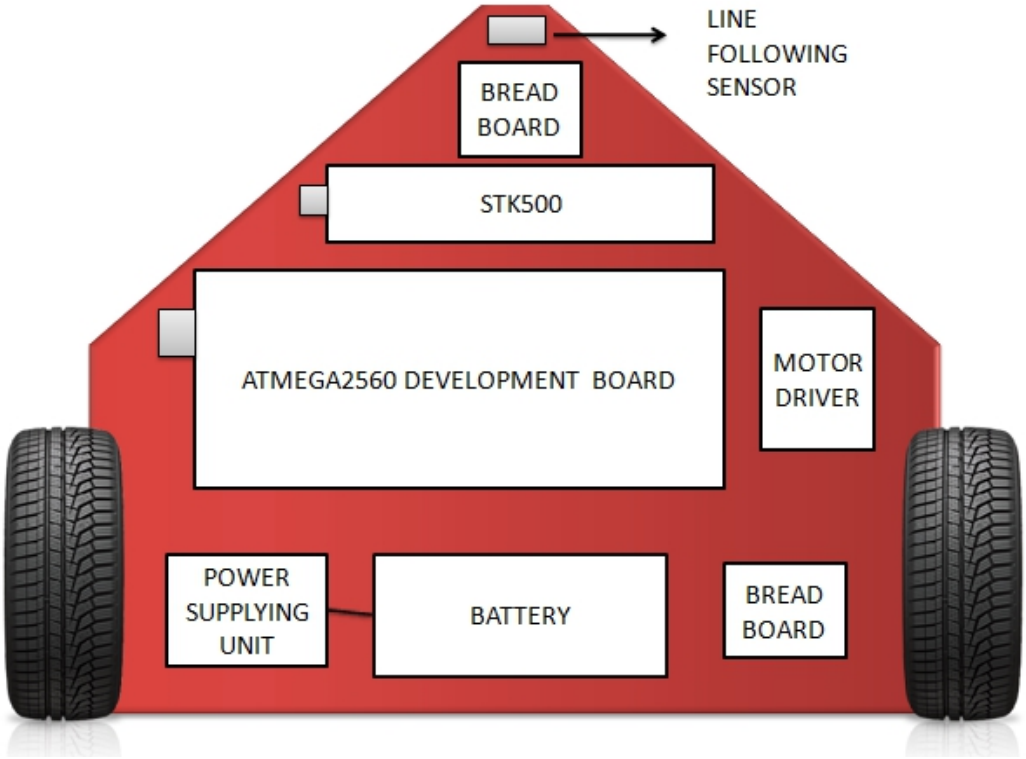
Word-limit: 150 words.>










LINE
FOLLOWING
SENSOR
BREAD
BOARD
STK500
ATMEGA2560 DEVELOPMENT BOARD
MOTOR
DRIVER
POWER
SUPPLYING
UNIT
BATTERY
BREAD
BOARD

1. **Sensor placement**

   The given white line sensor was placed on the bottom side of the front end of the bot next to the castor wheel so that the sensor values are more accurate.
   One of the Sharp proximity is placed on one side on the top part of the bot for wall following.The other sensor is placed on the front side in order to align the bot with the block to pickup and with houses to place the blocks.

2. **Arm Placement**

   The arm is placed on the front side of the top part of the bot so that it does not interfere with other parts of the bot while picking and placing.

3. **Battery**

   Since arm is kept in the front part of the bot, in order to balance the weight we kept the battery on the backside. It was placed in between the motors so that there is no imbalance in loads for each motor.

4. **Shape of the Chassis**

   The chassis of the bot was cut in an irregular hexagonal shape with the width of white line sensor in the front and about 20cm width at the back.This was done to take away extra portion of the chassis which could interfere with the balance since there is only one wheel at the front .

5. **Material of the Chassis**

   The chassis of the bot was made using an Polycarbonate sheet.This material was easy to cut,rigid,flexible and durable.This material was also light weight so that the movement of the bot will be smooth and power efficient.It was also cost efficient.

d. Using the designed robot, make it move by 10 cm forward, 10 cm right, 10 cm left and 10 cm backward. (15)

<Put the unlisted YouTube video link of the above process here>

LINK: https://youtu.be/Uu0pNFMBmoY

e. Identify the major components provided to you and explain the role/purpose of each component that is required for designing the robot for the theme. (5)

< Team should classify the components into various categories: mechanical systems, electronic systems etc. and mention how these units will be used in the theme. You may draw diagrams/figures to illustrate your answer.

Answer format: Bulleted form

1. Component 1

2. Component 2
3. ….etc. >

ELECTRONICS COMPONENTS-

- **Atmega 2560 development board-**

  This is the main controller in the project. The data from the sensors (IR and Sharp Sensors) will be given to development board and it gives corresponding signals to the Motor Driver IC.

- **Sensors -**
  - Line following sensor-
    - Used to detect the black lines for line following.
  - Sharp sensor-
    - Used to detect the construction material .
    - Used to detect wall for effective wall following.
- **Motor driver-**

  L298N motor driver is used to drive the motors of the robot.It receives signal from atmega board based on the information from the sensors.

- **Indicating Devices-**
  - Buzzer-

    It is used to produce beep sound to indicate us that the task is complete.
  - LCD-

    It displays the time instantaneously from the robot start till the end of the task.

- **Power-**
  - A 12V 2200maH Li-ion battery is used to power up the robot.
  - A battery charger is also provided to charge up the battery.

MECHANICAL COMPONENTS-

- **Actuators-**
  - Geared DC motor-
    - This motor is used to move the robot in different direction.
    - It provides more torque than a normal motor and can be used to carrying some load as well.
  - Servo motor-
    - This motor is used to rotate any object through a certain angle with great precision.

- Used in building the robotic arm for pick and place mechanism.

f. Explain the components that you will be using to design the robotic arms and its working for the theme. How the arm will be mounted on the robot (left, right, back, front) , also justify your mounting strategy. (10)

< Team should classify the components into various categories: mechanical systems, electronic systems etc. and mention how these units will be used in the theme. You may draw diagrams/figures to illustrate your answer.

Answer format: Bulleted form

1. Component 1
2. Component 2
3. ….etc. >

1. Servo Motors-

   For designing the arm we need two servo motors ,one for lifting it up and down and the other for carrying the material.

2. L-clamps-

   For the arm we need L-clamps to fix the flaps parallel to the block.

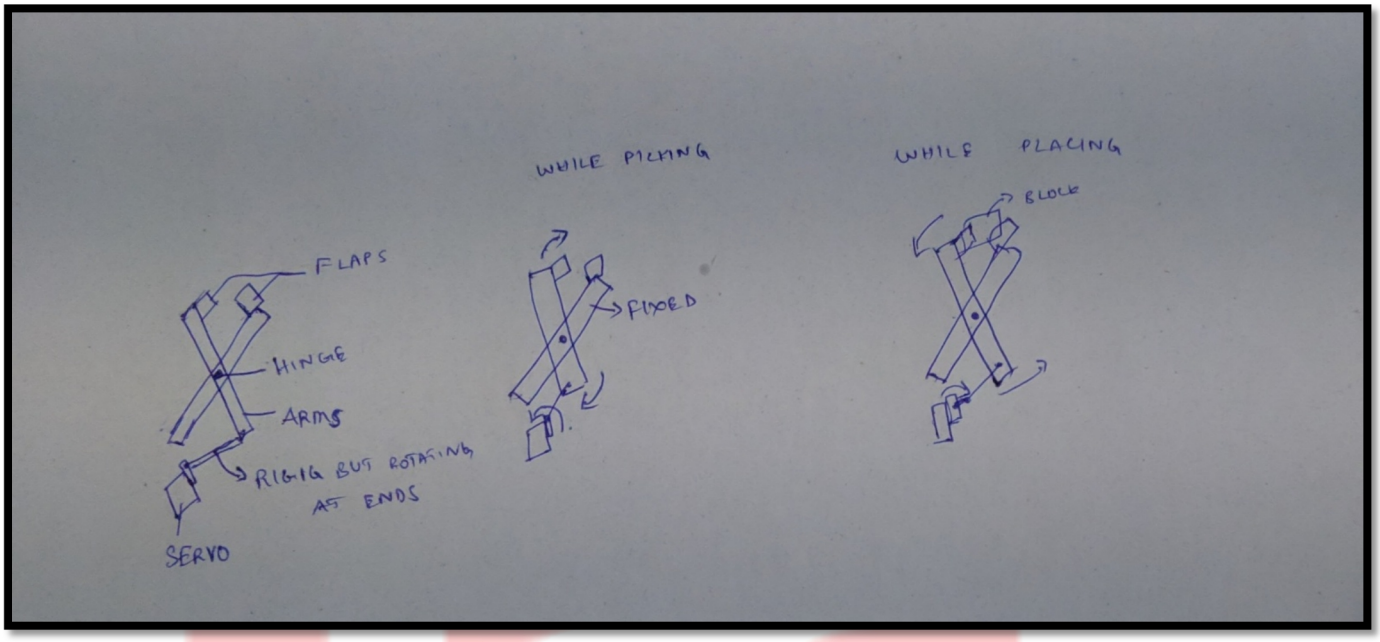
MOUNTING STRATEGY-

1. The arm was mounted on the front side for easy operation of the arm.
2. It will be uneven and hard to pick and place an object when the arm is placed on its sides.This happens as sometuimes we might need to turn 180 degrees to pick a specific object in those cases.
3. So placing the arm in the front or the back side is easier as we will have to turn only 90 degrees always.
4. The arm is not placed on the back side to balance the weight on the backside as all the heavy materials were placed at the back.

MECHANISM-

1. For the mechanism of the arm,we implemented a scissor-like mechanism.One servo motor was placed at the front tip of the top layer of the bot to control the up-down movements of the bot.
2. A beam like strip is used from the arm of the first servo to which the second servo is attached.
3. The second servo takes care of grabbing and leaving the block.The hands are designed similar to a scissor.

4. To the second servo one hand is attached and other one is fixed.The flaps are attached perpendicular to the hands.While grabbing the hand comes close and while dropping it moves away.



g. What are the challenges would you expect to face while designing the robotic arms to pick and place the Construction Materials and how will you overcome them?

(5)

< Answer format:

Challenge 1:
Solution 1:
Challenge 2:
Solution 2:
…….etc. You can also draw some diagrams/figures to illustrate your answer in a better way.>

1. **Challenge 1:**
   The up-down servo must be placed at the tip of the top layer so that it can reach the bottom without the interference of the rest of the bot.But since its weight is placed on the tip,the weight creates a cantilever effect and bends the sheet.

   Solution:
   We added a extra pillar at that position to prevent this from happening and give extra support to the arm.

2. **Challenge 2:**

The bot must be exactly in line with the block so that it can pick it properly.It might not pick it properly if it deviates a little bit also.

Solution:
We are using one Sharp sensor to align the bot properly to pick the material.

3. **Challenge 3:**
Due to the material used and the length of the arm it bends slightly as it is hanging.

Solution:
We plan to attach a rigid and light material in the bending portions to prevent the arm from sagging.

h. In this theme, we use the following formula as mentioned in Judging and Scoring section of Rulebook:

Total Score = (600-T) + (CP*30) +(CD1*80)+ (CD2*100) + (WHB*100) + (B*100) – (P*50)

What will be your strategy to earn maximum points and Bonus points in a run (given the following Configuration Table)? (10)

House		Construction Materials Required	
H1	low-rise	Brick	Sand
H2	high-rise	Gravel	
H3	high-rise	Cement	Brick
H4	low-rise	Electrical fittings	Sand
H5	high-rise	Gravel	Paint

<Answer in not more than 100 words>

- First,we will try by making the robot picking up one CM at a time and then placing the CMs at the respective houses.Then we will make the robot pick up multiple CMs at a time.If the time taken to finish the task by the former is less than the later method,then we would stick with the first method(picking up one CM at a time).

- After implementing this basic idea,we would then modify our algorithm to place the CMs at H5 first(white house bonus) and compare with the basic one and then implement the one which fetches us the maximum marks.

- Also we will make sure that the maximum time taken to finish up the task is less than 10mins and complete it without any penalty.

i. Explain your strategy in following **(10)**

I. Wall,
II. Zig- Zag and
III. White line

<Answer in not more than 100 words>

I. WALL:

- We will use only one sharp sensor for wall following which will be placed in the extreme left side of the robot.This sensor would then measure the robot distance from the left wall(say LD).With this distance,since the distance between the walls is known,the distance of the bot from the right wall(say RD) can found out by
- RD=30.48-(LD + Width of the bot)
- In this way,one sensor can be effectively used to find out the distance of the bot from both the walls and based on that,we will make the robot move through that path.
- **Note:**

  In case it the bot movement is not feasible with one sensor,then we can use the other sharp sensor for wall following.The block alignment in that case can be done by having only center white line sensor alignment.

II. ZIG-ZAG:

- In this path,we will be using the line sensor and when it does not detect any black line,we will keep checking for black line by turning 1^{O} anticlockwise first.We will follow this procedure until it finds a black line or is rotated by 60^{O}.
- If it still doesn't find the black line,then it is made to rotate back clockwise to its original position and the above procedure is applied clockwise.
- In this way,bot will eventually find the black line which it has to follow based on the line sensor readings.

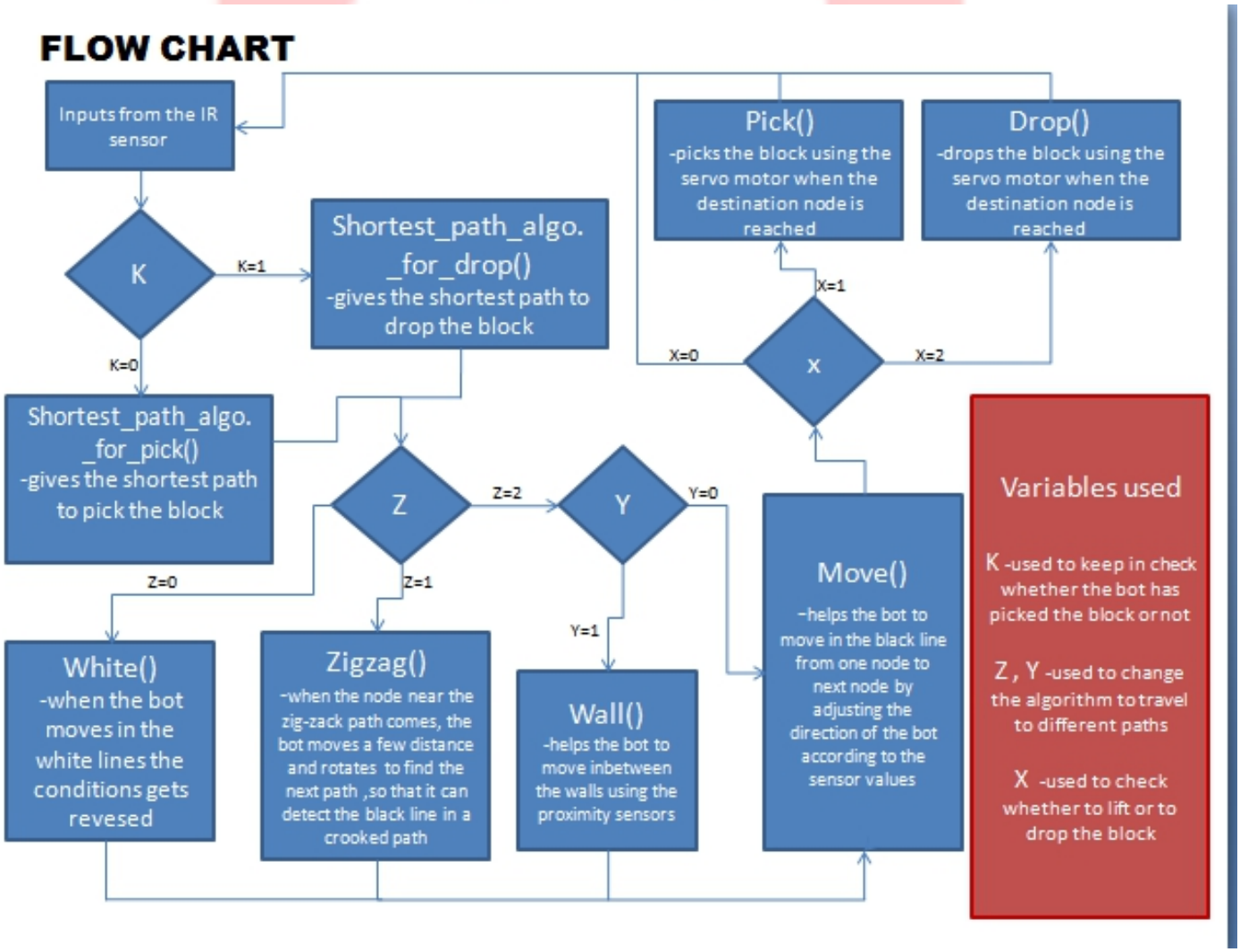
III. WHITE LINE:

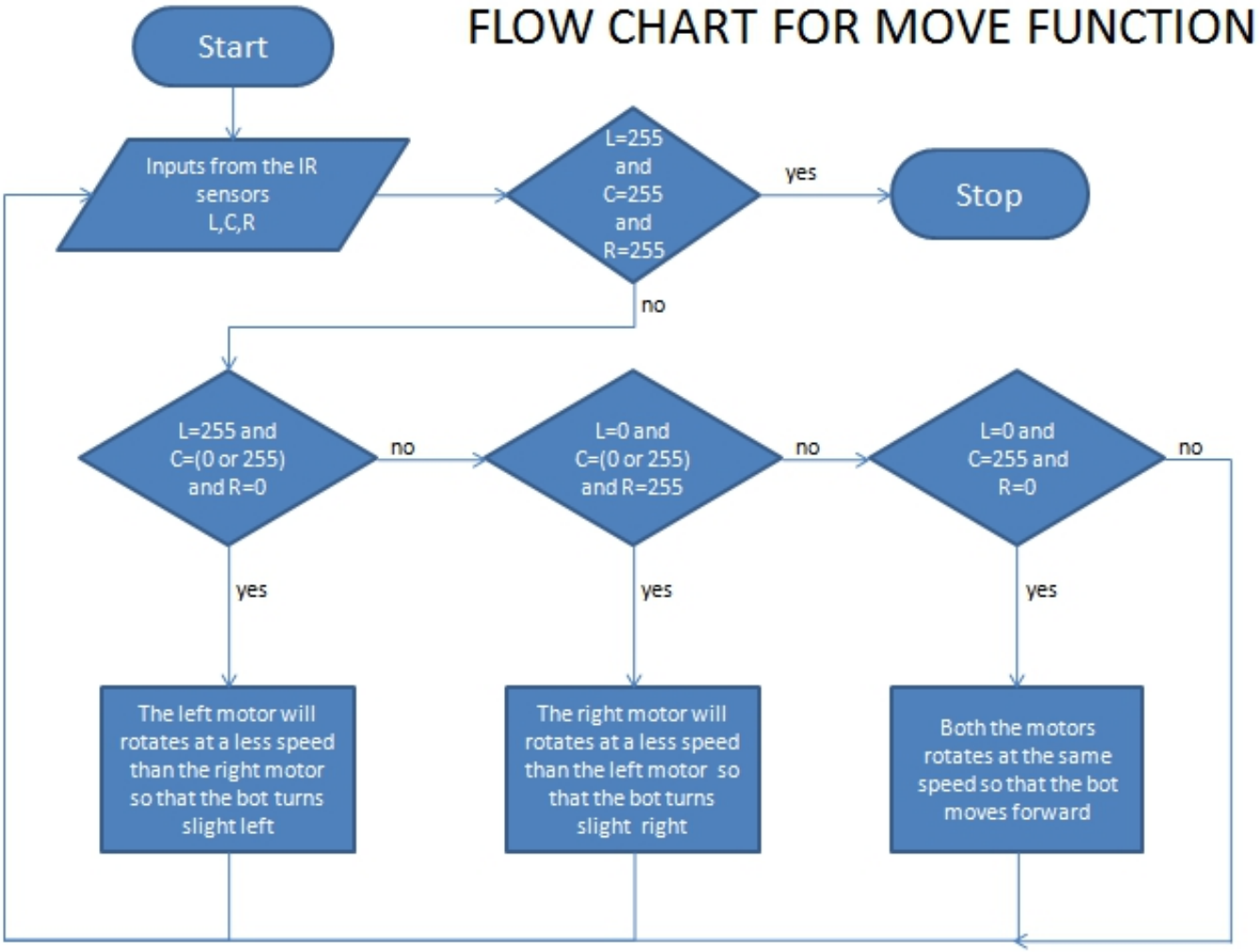
- In this path,the same black line following function is used but the inputs may be reversed based on the readings.

- If the center sensor reads a value less than the threshold and the other two sensor gives a value greater than the threshold value(i.e a white line),then the readings are reversed and passed to the function.
- If not,then the readings are passed to the line_following function as it is.
- The line following algorithm remains the same only the input changes.

j. Draw the complete flow chart of the algorithm used to solve the problem. (15)

<Use proper flowchart methodology. You can use already available software/application for creating flowcharts.
Important functions should be clearly explained.>




FLOW CHART FOR MOVE FUNCTION
Start
Inputs from the IR sensors L,C,R
L=255 and C=255 and R=255
yes
Stop
no
L=255 and C=(0 or 255) and R=0
no
L=0 and C=(0 or 255) and R=255
no
L=0 and C=255 and R=0
no
yes
yes
yes
The left motor will rotates at a less speed than the right motor so that the bot turns slight left
The right motor will rotates at a less speed than the left motor so that the bot turns slight right
Both the motors rotates at the same speed so that the bot moves forward