



NATIONAL ENGINEERING ROBOTICS CONTEST 2025



THEME: INDIGENOUS CATEGORY

National Engineering Robotics Contest

A joint venture of NUST and STEM Careers Programme (HEC) Organized

by:

Department of Mechatronics Engineering,

College of Electrical and Mechanical Engineering (CEME),

National University of Sciences and Technology (NUST), Islamabad, Pakistan &

National Centre of Robotics and Automation (NCRA)



CHANGE LOG

The table below will list the pages on which changes have been made to the theme.

Revision Date	
24-01-25	3D map of the arena is added. Website of the NERC is updated in the document. Dimensions of the fruit box is added
21-02-25	Component list updated Dimensions of fruit box updated
24-03-25	Rules regarding Fruit Box Position Map reading updated. (sec 4.5) Tolerance along with picking of fruit box elaborated (p. 21)
21-5-25	Rules regarding Hard code, reading of Position Map, location of Flag bearer and reference arena is updated on page#8.

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NOTE:

1. Any correspondence with the NERC officials via e-mail, telephone, or any other means will not be considered as part of the rules (unless uploaded as an FAQ on official NERC website).
2. In all matters of interpreting the rules before and during the Contest and in any issues not covered by these rules, the decisions of the Contest Judging Committee will be considered final.

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1 INTRODUCTION

The National Engineering Robotics Contest (NERC) is a joint project of the National University of Sciences and Technology (NUST) and Science Technology STEM Careers Program HEC to promote research in the field of robotics and its related fields in Pakistan. We, from the Department of Mechatronics Engineering, welcome you all to participate in 21st National Engineering Robotics Contest (NERC 2025). This competition will provide a common platform for the integration and evaluation of various electromechanical designs, control and path planning algorithms, and agent architectures.

Over the years, NERC has grown increasingly popular among students as well as engineering departments across the country. The Engineering students from all over Pakistan participate in this competition. Many students participate in this contest in their final years of undergraduate degree and take the contest theme as their Final Year Project, thus becoming part of human resource required in field of robotics and automation. This not only adds value to the competition but also resolves our pledge to bring exciting new challenges every year for the advancement of robotics community at an increasingly wider scale. Robotics is a buzz word at today's technology forefronts. Due to exponential advancements in fields like high performance computing, computer vision, computer networks, material sciences and power electronics, the growth experienced by robotics in past few years is unprecedented. Robotics is the only field which can add precision while replacing the slow manual labor in the contemporary industrial world. Thus, this field faces enormous pressure from industry to produce all-purpose mobile manipulator robots which can perform complex tasks like grab, navigate and place objects at desired locations autonomously. The future of Pakistan relies heavily on advancement in the fields of engineering and science, events of this nature will encourage and motivate students to improve their technical skills in leaps and bounds. The focus of NERC 2025 theme is to create an autonomous robot that can automate fruit box localization, identification, and sorting. In this theme, the robot's task is to localize the different colored fruit boxes, pick and place them at defined locations in the field. The first team to successfully complete the task and reach the finish line will be declared **"The Winner"**.

2 CATEGORIES

There are two categories of the contest:

- Indigenous Robot category
- Modular Robot category

The purpose of this contest is to develop a sense of problem-solving, project- based learning, team-based learning, technical design, and ingenuity among the contestants.

2.1 INDIGENOUS ROBOT CATEGORY

Indigenous category includes robots that are constructed from scratch. Their mechanical structure, controls etc. are designed by the teams themselves. The electronic control modules including all electronic boards and motor drivers (unless specified otherwise) etc. should be designed and manufactured by the students.

2.2 MODULAR ROBOT CATEGORY

Modular/Lego category includes robots that are developed using ready-made kits for example Lego, EV3 kits, EDVON kits or NCRA robotic kit etc. The Modular category is further divided into two subcategories:

2.2.1 Modular School

2.2.1.1 *Lego School*

2.2.1.2 *Ready to Race School*

2.2.2 Modular University

2.2.2.1 *Lego University*

2.2.2.2 *Ready to Race University*

*This document describes the theme only for 1 Category – **Indigenous Robot Category***

3 CONTEST STRUCTURE

The contest will consist of two stages:

1. Heats/Qualifying Rounds
2. Head to head matches

3.1 QUALIFYING ROUNDS

Each robot will participate in the qualifying rounds (heats). There will be no head-to-head matches in heats. For qualifying rounds following rules will be observed:

3.1.1 There will be NO head-to-head matches. Each team will individually run their robots.

3.1.2 Seeding chart will be based on points scored by teams. If the points of both teams are equal, decision will be made based on time taken by both teams. The team with shortest time will be placed on higher seed position. If time of both teams is also same, the decision

of the higher seed will be based on the shortest distance from the next objective from the current position (as per discretion of judges). If all the above criteria are the same, coin toss by judges will decide higher seed position.

- 3.1.3 Each team will be provided with a maximum of 3 minutes to run their robot. A timer will be displayed for the audience, however, accurate time through the stopwatch will be recorded by jury.
- 3.1.4 A team can take as many retries as desired within 3 minutes without any penalty but only the total time taken, and final score will be recorded. (Refer to the section 7.9, **Retry** for further details)
- 3.1.5 When a team takes a retry, the score is reset to zero and the entire arena will be reset.
- 3.1.6 When the team is ready, and the whistle is blown, then the time will start.
- 3.1.7 If a robot is not able to successfully complete the task in time, then the time when team's flag bearer will call it off (By saying "STOP") will be recorded as the finish time.
- 3.1.8 Only the **flag bearer** has the right to say **Retry/Stop**. Other members of the group must refrain from saying Retry/Stop other than the flag bearer to avoid confusing the referee. If referee makes a call due to the confusion caused by other team members, the referee's call will be considered final.
- 3.1.9 Judges reserve the right to give a re-run to any team with zero score with justifiable reason (if required). This clause will only be applicable if the Judges, Jury and Referee agree to the re-run. This clause does not apply to the team's request but to reasons which are justifiable and acceptable to the judging committee.
- 3.1.10 If the robot completes all tasks successfully and completely crosses the finish line (scoring maximum point), the stop called by the flag bearer will be of no importance/significance.

3.2 HEAD-TO-HEAD MATCHES

After qualifying rounds, the top 32 teams (with non-zero score) from the qualifying rounds will go for head-to-head matches. The judges reserve the right to change top 32 teams (the number of head-to-head matches). The winners will be decided through a final match and Runner-up will be decided based on the outcomes of the semifinals.

4 CONTEST THEME

NERC 2025 theme is the continuation of last year's theme where the fruits have grown on the trees. In this theme, the task is to build an autonomous robot that will pick different fruit boxes on a farm and place them at designated stations. The first job of the robot is to locate the fruit boxes in the farm. The robot will identify the fruit boxes at the locations. Lastly, the robot will pick the fruit boxes from the location and place them in designated stations. The first team to successfully place all the fruit boxes in their designated locations and reach the parking area will be declared the winner. The Contest Arena, depicting a complete farm where the fruit box pick and placement is to be conducted, is shown in Figure 1. Details are as follow:

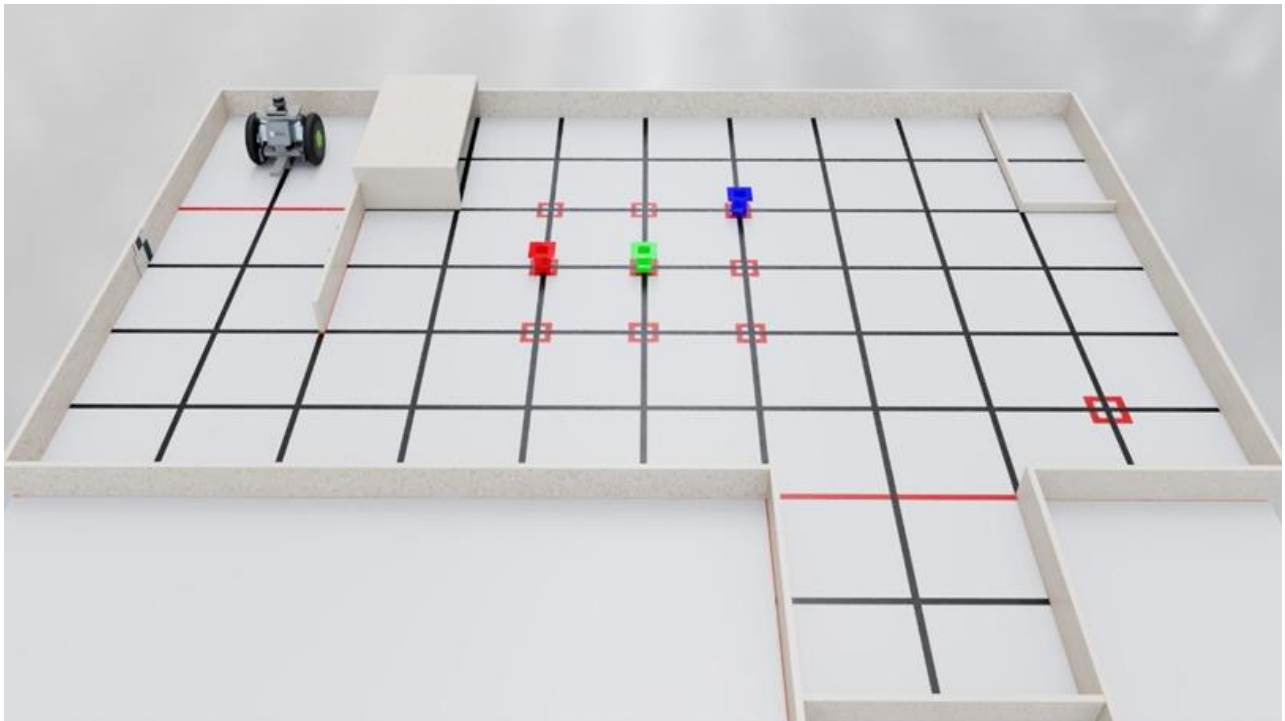
1. Laminated wooden sheets (lasani) are used for the construction of the arena. The floor of arena will be of white color as shown in the map (Fig. 1). All the boundary walls and separation walls have a height of 5 inches throughout the arena. The solid line made with black tape of 3cm width (Dotted Line in Fig 1) present on the floor of arena can be used for line tracking. The entire arena is divided into 12x12 inch grids.
2. The starting position and orientation of the robots are fixed. The robot must be placed behind the starting line shown in Fig. 1 with red color. The complete robot should be behind the line. The red colored line is only for reference in Fig. 1, it will be a solid black colored line on actual arena.
3. There is a defined region in the farm called a "Fruit box field" where fruits are planted (3x3 grid). The field is highlighted in Fig 1 with yellow color. Note that the yellow color and grid numbers are only visible in Fig. 1 for depicting the field region and are not present in the actual arena.
4. There will be a total of 3 differently colored fruit boxes (red, green, and blue) on the farm (detailed structure of fruits is given in Annex A, Fig. 2-5). The fruit boxes will be present in the farm. There are a total of 9 locations within the field where the fruit boxes may be present. For each match, fruit box position will be selected randomly.
5. To identify the exact location of the fruit boxes, present in the field, a "fruit box position map" is mounted on the wall of the farm (Fig. 1) along the path from where the robot will pass after the start of the match. The fruit box position map is mounted on two locations, one on each wall i.e. the left and right-side walls of the robot's starting path (grid locations (10,3) and (8,3)). The robot **May** read the "fruit box position map" to determine the exact placement of fruit boxes within the field. **The robot is not allowed to load the fruit box positions (through push buttons, keypad or any other input). Non-compliance to this rule will either lead to zero score for the run or disqualification based on judges' decision.** Please note that the fruit box position map will show the fruit boxes locations irrespective of the fruit box colors. The Robot may follow the black line (Reflective Tape) or wall of the arena to locate the objects. Line/wall following is not compulsory, however the robot can't go over the wall. **"One toggle switch may be used for selection of arena only."**
6. Once the robot determined the fruit box locations, fruit box color must be identified by the robot. Red fruit box, green fruit box, and blue fruit box are present in the farm. The fruit boxes will be picked by the robot and place them in station 1, station 2, and station 3. Station 1 (red

fruit box station) is located at grid location (7,3), station 2 is located at grid location (1,1) and station 3 is located at grid location (2,5). Station 1 is a 24x12 inches shaded area with a ceiling height of 6 inches. Station 2 is 24x12 inches walled area with wall height of 3.5 inches. Station 3 is shown by red-colored square box. The red color will be shown on the actual arena with red tape of 1-inch width. The dimension of the complete red square region will be 7x7 inches (including the dimension of tape). The blue/green fruit box to be placed within this red-squared region. No part of the fruit box should be outside the red-marked region. The black tape used to draw grids on the arena will be pasted above the red tape. Please note that red fruit box must be placed in the red fruit box station whereas blue fruit box and green fruit box can be placed in station 2 or station 3. However, no two fruit boxes must be placed in one station.

7. The robot has the freedom to schedule the sequence of events i.e. to pick and place different colored fruit boxes randomly. However, the placement of fruit boxes is to be done only at the defined locations of the farm for red fruit box. Blue and green fruit boxes have the flexibility to be placed in either of the two locations.
8. The fruit boxes must be placed within the station i.e. station 1, station 2, and station 3. The station 1 fruit box must be placed such that when seen from above, no part of fruit box is visible from all four sides. Station 2 fruit box must be placed inside the marked boundary whereas station 3 fruit box must be placed inside the red squared region such that some part of the red tape is visible on all four sides when seen from above. It can be placed on the red line as long as some part of the red tape is visible. The definition of placement of fruit boxes means that the fruit box must be placed within the respective stations and remain there till the end of the match. If during operation, the object is displaced from the locations the placement marks shall be deducted.
9. The robot is allowed to place the fruit boxes at any location in the arena during operation. However, marks will only be given when the correct fruit box is placed in the designated area.
10. The left and right-side arenas are mirror images of each other.
11. The team to successfully complete all tasks and reach the parking spot will be declared as the winner. A successful "reach" means all the parts of the robots have crossed the parking entrance line (represented with red color in Fig.1) and no part is on and above the line. The red colored line is only for reference in Fig. 1, it will be a solid black colored line on actual arena.
12. Dragging of fruit boxes is not allowed. The robot must pick the fruit boxes and place them at the designated area. However, while picking, if the fruit box is slightly dragged that may be allowed as per the discretion of the judges. Constant dragging of the object till the end point is not allowed.
13. After the start of the match, the team cannot touch the robot. In case of a retry, the teams can reset their robots.
14. Each team must bring their own robot. The maximum dimension of the robot is 12x12 inches (LxW).
15. The robot should be an autonomous and indigenously developed robot.
16. The programming of the robot is allowed only in the setup time of around 1 minute, it is not

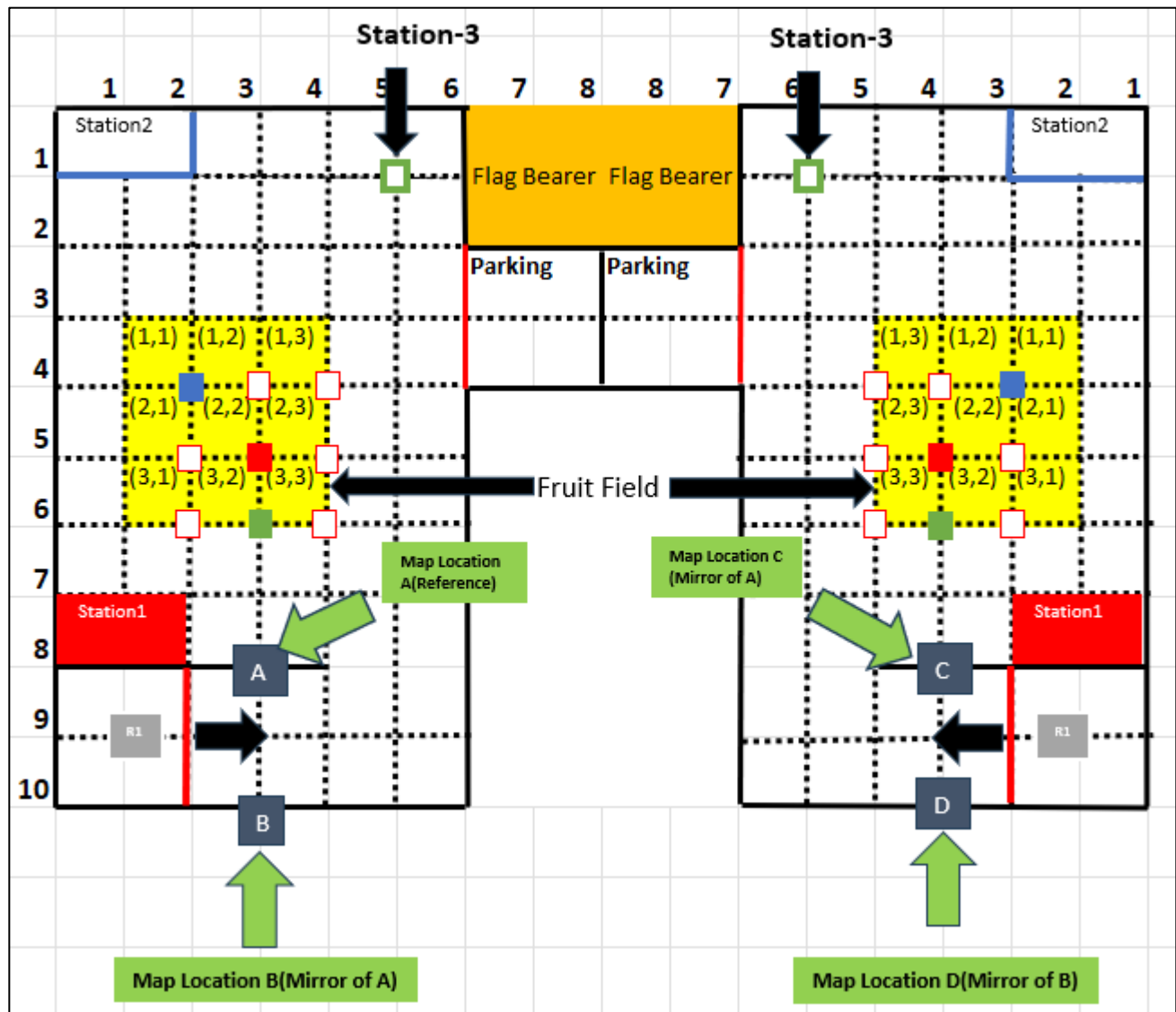
allowed once a match has started.

- 17. The Hardcode is allowed during Heats only**
- 18. The reading of the fruit box position map is optional for heats only.**
- 19. The Fixed Pattern of fruits for Heats is represented in the Anx-D**
- 20. The Left side of the Arena will be the reference Arena during the entire competition and the fruit position map for each arena is clearly pointed through arrows in the 2D Layout of the Arena.**
- 21. The Flag Bearer can only utilize the space shown in the 2D layout Arena with orange color, he/she is allowed to use the air space from this location to check if the box is placed within station 3, please ensure that the red boundary of station 3 shall be visible from all four sides when seen from the top. The referee call shall be final to assess if the box is within the station 3 (referee may call the judges/jury for opinion).**



(a)

Arena -2D Layout



(b)

Figure 1: Contest Arena (a) 3D view (b) top/2D view

- Each grid is of 12x12 inches.
- Both sides are mirrored images, the red, green, and blue boxes are showing different colored fruit boxes.
- Solid Black lines are showing the height of 5 inches wall and dotted lines shows the black tape of 3cm width on arena.
- The highlighted yellow area is only for reference; the fruit box plantation field will have white background like the rest of the arena.
- The highlighted orange area is also for reference

5 ROBOT OPERATION

The qualifying teams (those which qualify for the final rounds) will compete with each other in a knockout format. In each match two teams will be pitted against each other, running their robots side by side in the contest arena. Teams will be declared as Team A or Team B based on the coin toss before every match. The winner of coin toss will decide which arena to choose i.e. Left Arena or Right Arena. The left arena will be given a Blue flag while the right arena will be given a Red flag, hence the arena may be referred to as the Red or Blue arena.

Once turned on, the robot must be self-controlled without any human intervention and contestants are NOT allowed to touch their robots. After the blow of a whistle, the robot will have 3 minutes to complete the task.

During a retry, the layout of the arena shall remain SAME and shall be reset, however the point-scoring will restart from zero. The robot may navigate through the arena using any suitable technique. The robot may not displace any un-authorized item in the arena. Displacing any un-authorized item inside the arena will result in a forced retry or disqualification as per discretion of judges (Judges decision on declaring a displacement will be final). If the participating team sees that their robot has lost track of its location and is facing trouble localizing itself, the team can ask for a retry by raising their flag. During its motion, the robot may touch the walls of the arena without damaging them, but it is not allowed to use any sort of tactile sensor to drag along the walls. This will result in forced retry as per call of referee or disqualification as per discretion of judges.

In case of a tie, the contestant may be required to run a rematch, or the winner may be decided on a coin toss as per the discretion of the judges.

For a particular match, both teams will face the same layout of the arena.

6 POINTS

The point scoring is shown below in Table 1 Point Scoring.

Table 1 Point Scoring

Point Scoring:	Score
Picking of Fruit Boxes	3x10=30
**Placement of Fruit Boxes in the correct location	3x20=60
*Reaching the Exit Point	10
Total	100

[Note: Picking and placing points can only be awarded once per fruit box]

*Reaching means the robot must have completely crossed the Finish line and entered the parking Area.

** The fruit boxes must be placed within the station i.e. station 1, station 2, and station 3. Station 1 fruit box must be placed such that when seen from above, no part of fruit box is visible from all four sides. Station 2 fruit box must be placed inside the marked boundary whereas station 3 fruit box must be placed inside the red squared region such that some part of the red tape is visible on all four sides when seen from above. It can be placed on the red line as long as some part of the red tape is visible. The marks will not be allotted for placement if the boundary lines of stations are not visible on all four sides.

6.1 DEDUCTION OF POINTS

The deduction of points is shown below in Table 2. Deduction of Points

Table 2. Deduction of Points

Deduction/Penalty	
The robot fits in an area of 12x 12-inch square	No Penalty
Oversize Robot (14x14 inch square)	5 Points
Oversize Robot (exceeding 14 x 14-inch square)	Disqualification
Robots weighs less than 12 kg*	No Penalty
Overweight Robots (Weight between 12 and 14 kg)	5 Points
Overweight Robots (Weight exceeding 14 kg)	Disqualification
Damaging the arena/wall/sites/Tape/Objects	Disqualification

*This is the individual weight of each robot

The penalty handicap shall be applicable in heats and head to head matches.

7 RULES

The following are the rules governing the contest.

7.1 GENERAL

- 7.1.1 The Contest judges may stop any robot at any time if they feel that it is performing or is about to perform any action that is dangerous or hazardous to people or equipment.
- 7.1.2 All electronic circuits must be designed and fabricated by the contestants themselves.
- 7.1.3 Maximum effort in the design and fabrication of the robot shall be done by the contestant themselves.
- 7.1.4 Contestants are allowed to use only certain electronic components, list for which is attached at the end of this document.
- 7.1.5 Additional information regarding the contest rules and regulations may be found in the Tab of FAQs (<https://www.dmtsnu.com/nerc/>) and will be considered as part of the theme and rules. New FAQs are uploaded frequently so keep watching the FAQ corner for new information.
- 7.1.5 Any correspondence with the NERC officials via e-mail, telephone or any other means will not be considered as part of the rules (unless uploaded as a FAQ on official NERC (website). It is the responsibility of each contestant to be familiar with all the rules.
- 7.1.6 If both the teams have scored same points but are not able to complete the task in allocated time slot, decision of the winner will be on judges' discretion who will determine which robot is closer to finish the task first.
- 7.1.7 If both teams have scored the same points, have the same time and are at the same distance from the finish point, a coin toss will be used to decide the winner.
- 7.1.8 If any team wants to launch a protest (of any kind), they must do so within 15 minutes after the end of their match. The procedure and payment are outlined in Annex C.
- 7.1.9 Attempting to damage the game field or performing an act that fails to comply with the spirit of Fair Play will lead to the disqualification of the team.
- 7.1.10 In all matters of interpreting the rules before and during the Contest and for any issues not covered by these rules, the decisions of the Contest Judging Committee will be final.
- 7.1.11 Wireless Control of the Robot for operation is not allowed.

7.2 TEAMS

- 7.2.1 The Robots can be built by teams of currently registered students from Engineering Institutions and Polytechnic Institutions (these students can also be part of a robotic club). Each team can comprise a ***maximum of 6 members***.
- 7.2.2 If the students from two different Institutes/Universities join hands and form a team in collaboration, then the name of the Institute/University with maximum number of students in such a team would be registered or official consent from both institutions will be required at the time of registration before the contest start date.
- 7.2.3 A person can't participate in more than two teams of this category.

7.3 ROBOT SIZE AND WEIGHT

The robot fits within 12x 12-inch square at the time of measurement. If the area of the robot base is more than 12x 12-inch square but less than 14 X 14- Inch square, then points will be deducted. There is no restriction on the maximum permissible height of the robot. Any robot which does not fit in 14 X 14-Inch square will be disqualified. All robots will be carefully measured. All sensors mounted on the robot will be counted as part of the robot's total dimensions. If contestants want to add a flag, hat or other purely decorative, non-functional items to the robot, they may do so. The decorations may be removed for measurement purposes. The weight of each robot excluding decorations must not exceed 12 kg. Penalties are as detailed in 6.1 Deduction of Points will be levied if the robot does not fulfill the size and/or weight criteria.

7.4 ROBOT OPERATION

- 7.4.1 Any team that damages the arena will be disqualified.
- 7.4.2 The robot must not use any harmful substances such as oil, petrol etc. in its operation that can damage the arena.
- 7.4.3 The Robot CANNOT split after the start of the game, only one Robot is allowed to compete at a time.
- 7.4.4 The robot must not use any destructive or dangerous methods to displace any obstacle or box.

7.5 SENSORS

- 7.5.1 Robot is not allowed to use tactile sensor of any type for dragging along the walls, however it can use for sensing the walls.
- 7.5.2 Ultra-Sonic Range detectors (SONARs) or IR based proximity sensors (models specified in the components' list attached) can be used for sensing walls/Line.
- 7.5.3 The team may use any off-the-shelf encoders if they feel the necessity. Self-made encoders from discrete components are also allowed.

7.6 ELECTRONICS

- 7.6.1 All electronic circuitry must be designed and fabricated completely by the participants themselves. Circuits should not be fabricated by the help of any professional developers. Only the modules specified in the components list may be bought directly.
- 7.6.2 The participants must not use any pre-fabricated board or electronic circuitry. Any type of the electronic board or circuit must be etched by the students themselves. Circuits should not be fabricated by the help of any professional developers.
- 7.6.3 Microcontrollers specified in the components list must be used for controlling your robots. You can also use Microcontroller development boards specified in the list only. Microprocessors and Single Board Computers are not allowed.
- 7.6.4 Motor drive circuits should be designed and fabricated by participants themselves and made from discrete components like Transistors and logic circuitry. H-bridge IC's like L297 or L298 **ARE ALLOWED**. However, you may use Gate driver IC's e.g. IR2101/IR2110 etc. This clause is for the robot drive and mechanism motors only. The lifting mechanism motor can be controlled using H-bridge IC's.
- 7.6.5 No prefabricated modules are allowed, unless listed in the components list (Annex B) or allowed by the NERC coordinator in FAQs. If a component needs to be added then all of its specifications (datasheet, picture, location to purchase, price) **MUST** be emailed for formal permission.
- 7.6.6 All other components can be used in your circuitry. In case of any query, questions shall be emailed to NERC Coordinator at nerc@ceme.nust.edu.pk . The FAQs section on the website shall be considered part of the theme.

Note: Only the theme documents and the questions in the FAQ section of the official website (<https://www.dmtsust.com/nerc/>) shall be considered as official notifications.

7.7 POWER SUPPLY

- 7.7.1 The robot must be battery-powered.
- 7.7.2 The robot must not have any wired connections with its surroundings.
- 7.7.3 Voltage of the machine's electrical power source must not exceed 48-volt DC. **Power banks may be used.**
- 7.7.4 Power sources that are considered dangerous or unsuitable by the contest officials shall not be permitted.

7.8 DURATION OF MATCH

- 7.8.1 Each match will be of maximum 3 minutes.
- 7.8.2 Teams will be given around 1 minute for setting up the Robot at the start.
- 7.8.3 Robots can start at the instant when the start signal is given, and a whistle is blown. The Robot should be constructed so that it can be started in minimum possible steps.
- 7.8.4 Once the Robot moves, team members will not be allowed to touch the Robot or enter the Contest Arena. If any team member enters, forced retry shall be imposed.
- 7.8.5 Timing shall start once the start signal is given and the whistle is blown.
- 7.8.6 Time would be stopped as soon as Robot reaches completely into the parking spot. If a robot is not able to successfully complete the task, then the time when team will call it off (by the flag bearer saying STOP", will be recorded as the finish time. The team must leave their robots as they are on their current locations when time stop is called by them. They are NOT allowed to pick their robots up till the referee announces the end of the match. The team is not allowed to take a retry after the time has stopped or STOP has been called.
- 7.8.7 The team which picks all the fruit boxes and places them correctly, then reaches the parking spot first will be declared the winner of the match.
- 7.8.8 If both teams fail to complete the task, within the time limit, the team scoring more points will be declared the winner of the match.
- 7.8.9 If both the teams have scored the same points but are not able to complete the task in the allocated time slot, then winner will be decided on time. If both teams call stop at same time, then decision of the winner will be on judges' discretion who will determine which robot is closer to finish the task first. The distance of the robot's current location from the Finish Point (Parking Spot) will be measured, or decision shall be given by judges based on completion of task.
- 7.8.10 The Complete robot is required to cross the parking line for the run to terminate.

7.9 RETRY

If the robot is strayed due to some reason, retries are allowed.

- 7.9.1 There is no limitation on the number of retries and a team can take as many retries within the 3 minutes duration of the match. No Points will be deducted for retries but total score will reset to zero.
- 7.9.2 Each team would be provided with a flag of their respective team. If a team wants to take a retry, the flag bearer must raise the flag and say clearly "retry". Once the referee announces a retry, the team shall place its robots at their starting location.

- 7.9.3 If a team wants to stop their robot during the match, the flag bearer must raise the flag and say “stop”. The team can then turn off their robot, but they must not move it. The time at which the robot is stopped would be recorded as the final time. The team must not enter the arena until referee has acknowledged the “STOP”.
- 7.9.4 For each retry, robots must be started again from the start point. Points will reset to zero.
- 7.9.5 Arena Management team is responsible to reset the arena, any team member is not allowed to interfere or do the resetting of arena themselves. If such an act is done, referee will call retry.
- 7.9.6 Separate time for individual retries will NOT be recorded or maintained. When a team takes a retry, it is only allowed to restart the robot.
- 7.9.7 Once the start whistle is blown, the team can’t reprogram their robot.
- 7.9.8 If the contestants enter the arena during the match, it will automatically be counted as a retry.
- 7.9.9 Once the stop has been called by the flag bearer or the task has been completed (obtained full marks), retry will not be allowed.
- 7.9.10** Only the **flag bearer** has the right to say **Retry/Stop**. Other members of the group must refrain from saying Retry/Stop other than the flag bearer to avoid confusing the referee. If referee makes a call due to the confusion caused by other team members, the referee’s call will be considered final.

7.10 DISQUALIFICATION

The following behavior shall be considered for disqualification by the referee and the team could possibly be disqualified:

- 7.10.1 Attempting to damage the game field.
- 7.10.2 Performing any act that fails to comply with the spirit of Fair Play.

7.11 PROTEST PROCEDURE

The protest procedure is as follows:

- 7.11.1 The team must launch a protest (submit a complete protest form to the head jury) within 15 minutes after the end of their match.
- 7.11.2 The team must collect the protest form from the head jury on request or use a hard copy of the form in Anx C.

- 7.11.3 Only one member of the team must submit a non-refundable protest fee of Rs. 5000/- along with the protest form.
- 7.11.4 A complete protest form includes submission of the protest fee.
- 7.11.5 The head jury will forward the case to the judges.
- 7.11.6 The judges will decide on the protest's validity and render their decision.
- 7.11.7 In case of noncompliance of any of points above, the protest will not be considered valid.
- 7.11.8 The judges' decision will be final.

8 TEST RUN

Contestants will be given time for trial run one day before the contest to calibrate their robot/sensors on the actual arena/game field. However, considering the huge numbers of participants, practice time may be limited. Scheduling shall be done by the organizers.

Annex A: Fruit Box Position Map

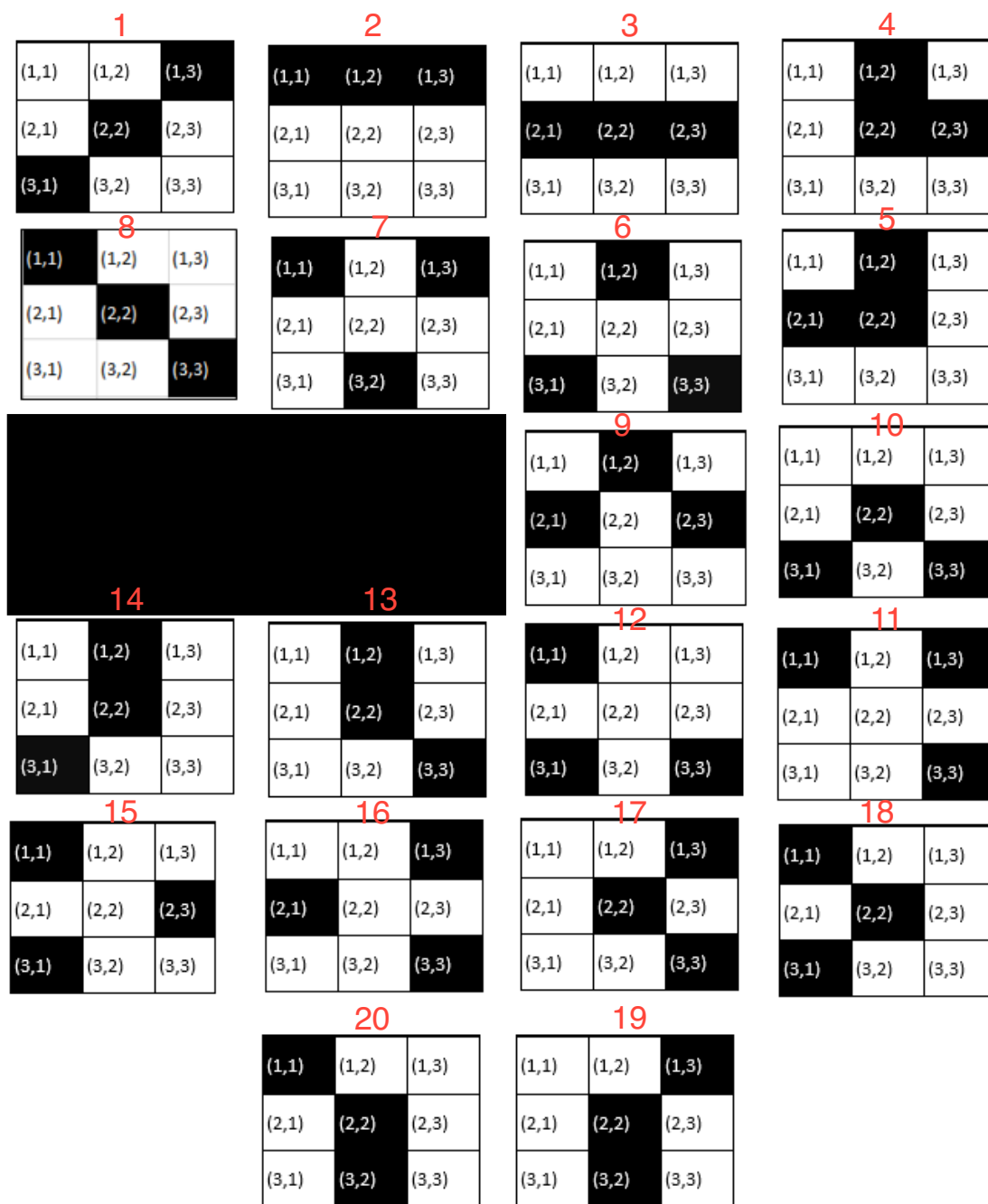
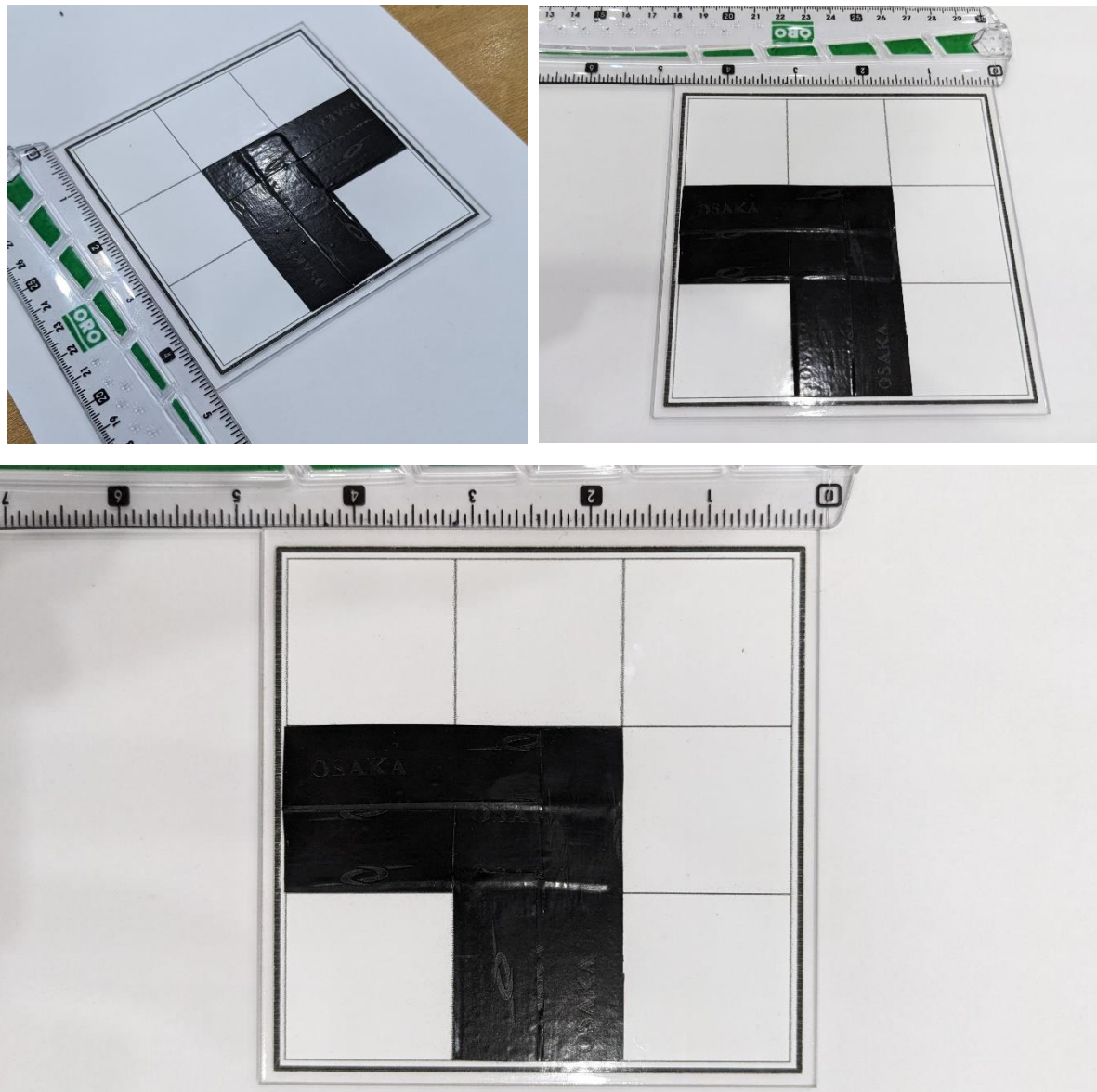


Figure 2. 20 possible combinations of Fruit Boxes placement in field

- The dimensions of the Fruit Box position map are 4.5 x 4.5 inches.
- Each cell has a dimension of 1.5 x 1.5 inches.
- There are 9 possibilities against the position of each Fruit Box.
- The black cells depict the location of Fruit Boxes within field.

- Refer to Figure1 for the respective position on arena.
- The coordinates shown above are only for reference



- Images of Fruit Box Position map
- Fruit Box Position map is printed on stickers and stuck onto transparent acrylic plates.
- Black electric tape is placed on black matrix (Fruit Box Position) for better sensor detection.

Figure 3. Details of Fruit Box Position Map

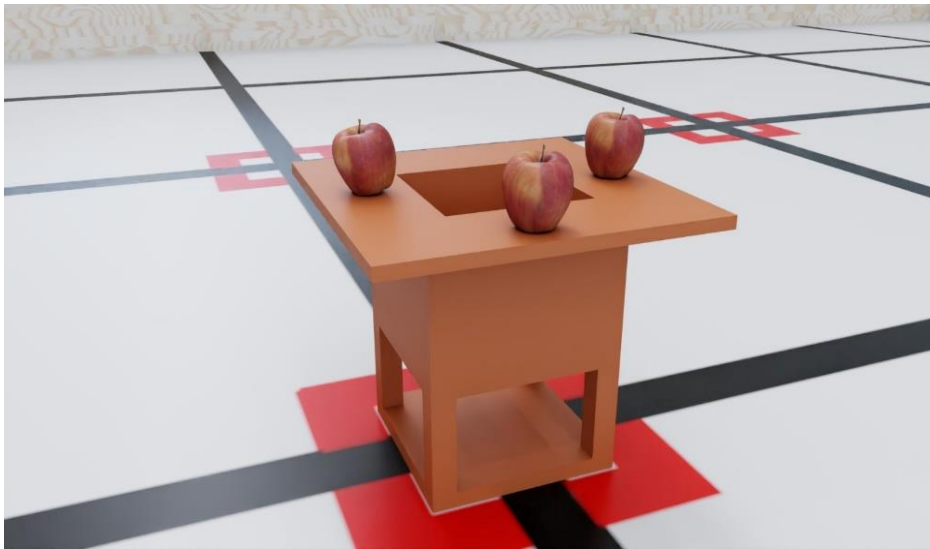


Figure 4: Fruit box 3d Model

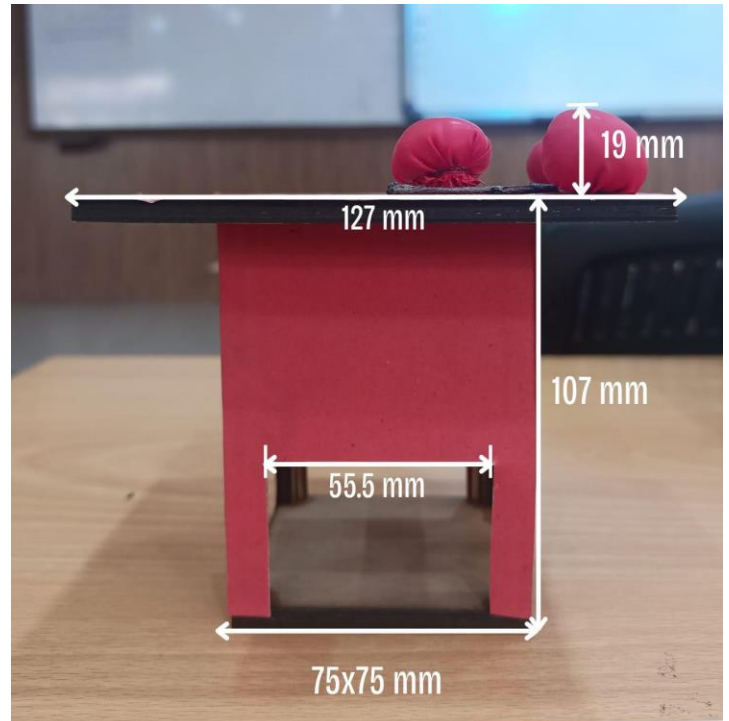
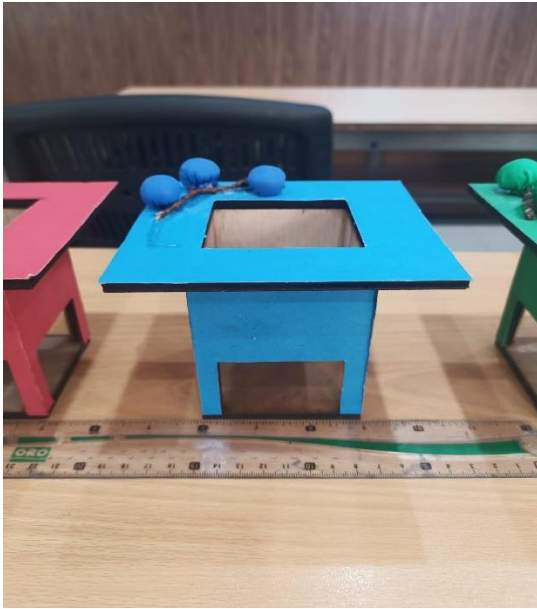
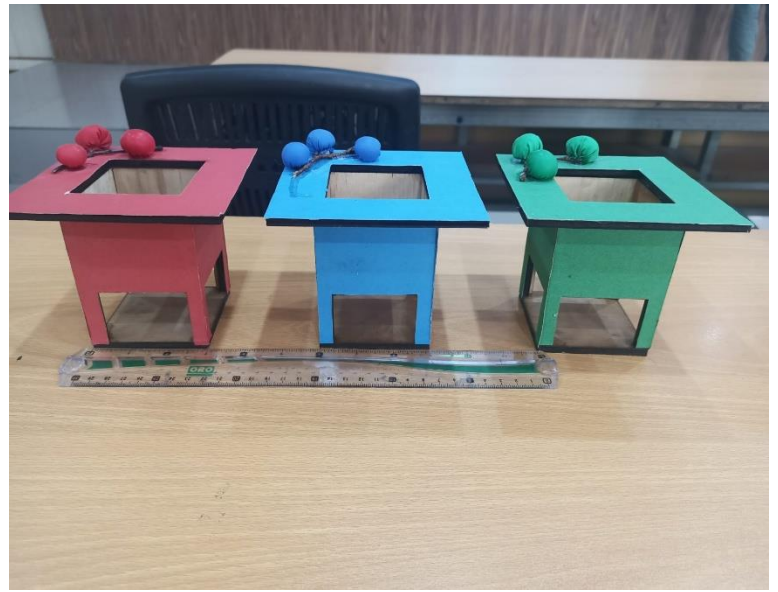


Figure 5: Fruit box Dimensions



a. Front



b. Top

Figure 6: Decorative cover to represent fruit box (a) Front (b) top

Note: The fruit box has a tolerance of $\pm 0.2''$ from all sides. The robot has to pick the whole fruit box for the task to be completed. The 3 round balls on top of the fruit box are just for decoration but add to the total fruit box height of 5".

Annex B: COMPONENTS LIST

Please see the components below. In case of any query, questions shall be emailed to NERC Coordinator at nerc@ceme.nust.edu.pk . The FAQs section on the website shall be considered part of the theme.

Table 3 Components List

Sensors	Allowed Parts
Wall Following Sensor (Proximity Sensors)	1) IR Sensors: Sharp GP2Dxx & GP2Y0xx series sensor 2) Sonars: Maxbotix Maxsonar Range Finder series (XL,LV) Parallax PING))) Ultrasonic sensor, HC-SR04 3) Self-made from discrete components
Color Sensor	1) All types of color sensors are allowed 2) Self-made from discrete components
Other Sensors	1) Compass/Magnetometer: HMC5883L 2) IMU: MiniIMU-9 v3 Gyro Accelerometer and Compass (L3GD20H and LSM303D), MPU-6050 Accelerometer + Gyro 3) IMU: GY-80 ADXL345 Accelerometer 4) Accelerometer : ADXL345 5) Gyro: LPR550AL Dual-Axis (Pitch and Roll or XY) Gyro ,LPR550AR Dual-Axis (Pitch and Roll or XY) Gyro
Microcontroller Note: No wireless add on can be connected with the controller.	1) PIC16F/PIC18F family 2) AVR ATTiny, ATmega, 3) 8051, 8052, 8055 4) All types of microcontrollers without wireless communications are allowed

<i>Development Boards</i>	1) Arduino Mega, Uno, Nano, mini, Pro Series, Leonardo, Esplora, Due 2) Pinguino 26j50 3) Amicus 18 4) Raspberry Pi Model B, model A, Pi zero (non W) Note: Only those Development Boards are allowed which don't have Built in Wi-Fi. Any external Wi-Fi module is also not allowed
<i>External Shields</i>	<i>Only SD card shield allowed</i>
<i>Motor driver</i>	<i>Self-made from discrete components for drive motors. H-Bridge ICs are also allowed however, readymade modules are not allowed.</i>
<i>Motor</i>	<i>Any type of motors is allowed. Encoders are also allowed</i>
<i>Battery</i>	<i>Any type (Power Banks are allowed) Buck/Boost converter modules are allowed.</i>
<i>Wheels</i>	<i>Meccanum/Omni wheels are allowed</i>
<i>IR Sensor</i>	<i>BRD1000 Array Sensor</i>
<i>Free Wheels</i>	<i>Any type is allowed</i>
<i>Relay</i>	<i>Relay module is not allowed but relay component alone may be used only.</i>

Annex C PROTEST FORM

Protest Form

Team Name:	
Team ID:	
Team University:	
Team Members:	
Match finish time (to be filled by Head Jury)	
Launch time of Protest (to be filled by the head jury)	
Non refundable Protest fee Payment (to be filled by head jury) @ 5000 Rs/- per protest	

Reason of Protest: _____

***By Signing below, I confirm that the decision made by the judges is final and I will not protest it any further.**

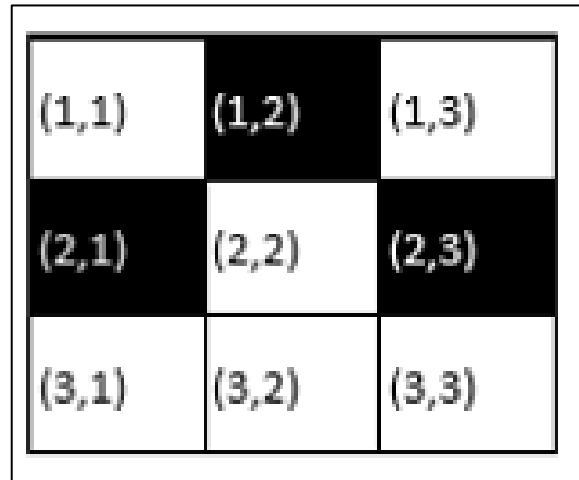
Signature of Team Leader

Signature of Head Jury

Decision of Judges: _____

Signature of Head Judge

Annex D Fixed Pattern for Heats Only



(1,1)	(1,2)	(1,3)
(2,1)	(2,2)	(2,3)
(3,1)	(3,2)	(3,3)

Figure 2: Fixed Pattern for Fruit Position Map for the Heats

- The above pattern will be the fixed pattern for the Heats only
- The same pattern will be placed in the mirrored arena