JEWEL HEIST

1.INTRODUCTION:

You are the mastermind of the famous armed robbery, Jewel Heist. You have been planning this robbery for almost a year now and you've come with your mind fixed on the goal. According to the plan, you made your entry into the international hotel successfully. You managed to slip past the tight security of the hotel by using a few simple tricks you devised and you made your way into the locker rooms in the heavily guarded basement. The lockers were cracked open and you have managed to strip the hotel of cash and jewellery worth billions.

But your mission won't be truly complete as long as you haven't obtained the one thing you had meticulously planned the entire operation for – the beautiful, priceless, Crown Jewel which was in the central locker. This particular locker has been specially designed and customized according to the hotel's need. The one and only way to open this is by fixing a jewel grid, an intricate combination of rubies, emeralds, sapphires, topaz and diamonds and these keystone gems are placed all around the hotel. Now you need to collect the gems and fix the grid to reach the priceless Crown Jewel!

This year, at Shaastra -2015 display your talent and make Jewel Heist successful. It is time to loot awesome cash prizes!

2. ARENA DESCRIPTION:
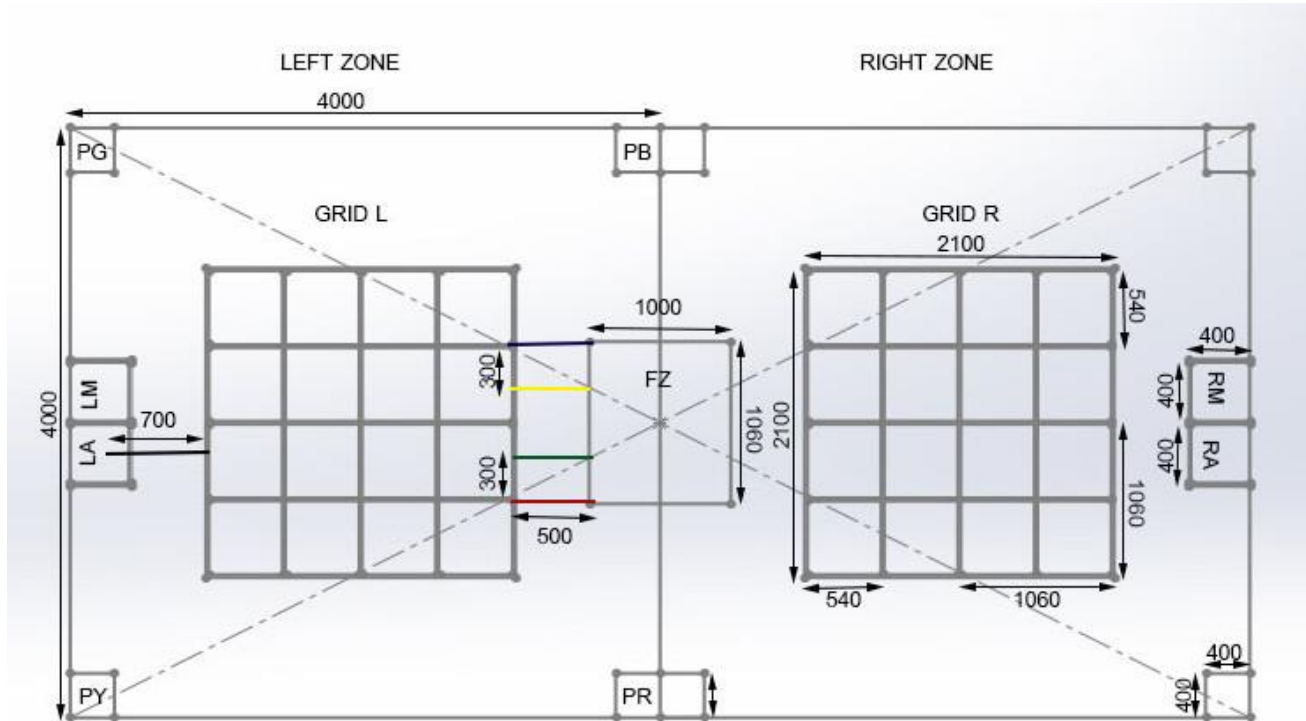
2.1 The entire arena is a rectangle of dimensions 4000*8000 mm is divided into two parts symmetric squares of side 4000 mm length each.

2.2 Team L will be playing in left zone and team R in right zone.

2.3 LA and LM denote the starting point of Autonomous robot and Manual robot in the left zone.

RA and RM denote the starting point of Autonomous robot and Manual robot in the right zone.

2.4 There are two square jewel grids, Grid L and Grid R in the left zone and right zone respectively as shown in Fig1. The grids are connected to the center of starting point of autonomous robot by a 20mm thick black line as shown in Fig 1. The line in zone R is a mirror image of one shown in zone L.
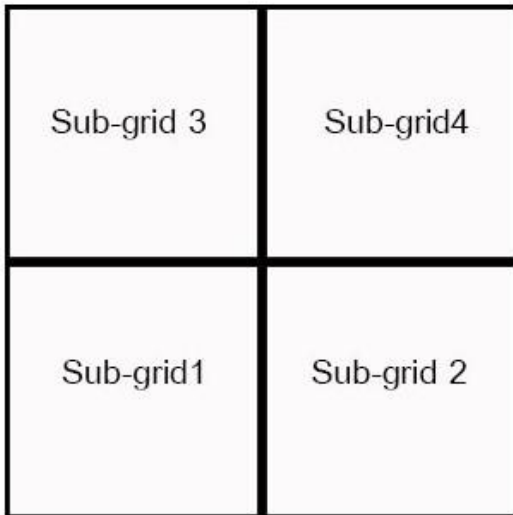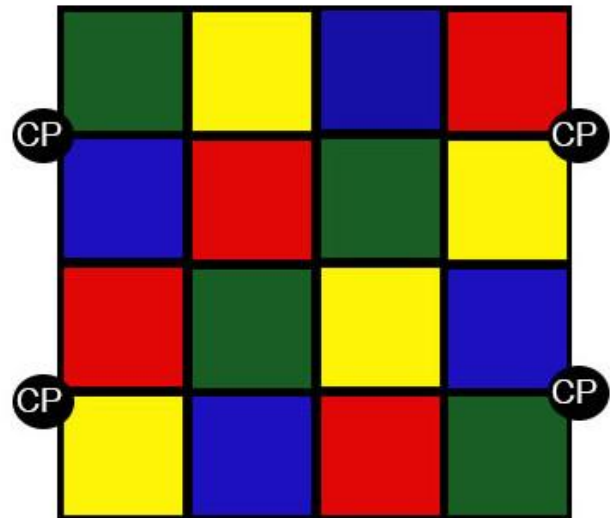
Grid Left

Grid Left

Fig 2.a

Fig 2.b

Note: The above image is only a sample grid and the actual grid may not be the same.

Jewel grid:

2.4.1 Each grid is a square of 2100*2100 mm (including the black line) with total 16 squares of 500*500 mm(excluding the blackline) each.

2.4.2 Each square of 500*500 mm is surrounded by a border of black line with width 20 mm.

2.4.3 The grid is divided into 4 sub-grids (sub-grid 1, sub-grid 2, sub-grid 3 and subgrid-4) as shown in the Fig2 (a) where each sub-grid contains 4 squares of the 16 squares. Fig.2 shows left grid. **Right grid is the exact mirror image of the left grid.**

2.4.4 These 4 squares in a particular sub-grid will have a different color (Blue, Red, Green and Yellow). The colors of all squares are denoted in the Fig2 (b).

2.4.5 At the beginning of the game one jewel (block) will be placed in any one of the four squares of each sub-grid.

So, totally 4 jewels will be placed in the entire grid.

2.4.6 The jewel will be placed at the center of the square. Each jewel is a hollow wooden cube of dimensions 100*100*100 mm.

2.4.7 The check points for autonomous robot in the grid are as marked in Fig2 (b).

2.5 The check point for manual robot is its starting point.

2.6 There are 4 pickup zones PB, PR, PG, PY in zones L and R (as shown in Fig.1) of dimensions 400*400 mm each. The pickup zones in zone R, are mirror images of those shown in zone L.

2.7 Pickup zones PB, PR, PG, PY contain 3 sapphires (blue block), rubies (red block), emeralds (green block),topaz (yellow block) jewels respectively. Each pick up zone has one diamond (white block) in addition to the three color jewels corresponding to it. Each jewel is hollow wooden cube of dimensions 100*100*100 mm and of the mentioned color.

2.8 There are 4 colored lines joining the jewel grid and final zone FZ as shown in Fig.1 in both zones zone L and zone R. The length of each line is 500 mm and width is 20 mm. The lines in zone R are mirror images of those shown in zone L.

2.9 The final zone FZ is in the center of arena as shown in Fig.1. It is a rectangle of dimensions 1060*1000 mm including a border of black line around it. The width of the line is 20mm.

2.10 If the autonomous robot is performing image processing, overhead camera (s) will be provided in the arena. The details of the camera will be updated on the website soon.

2.11 Color of any other part of arena if not specifically mentioned above can be assumed to be white.

3.MISSION
The jewel grid has to be fixed. The robots will team up to gather all the jewels – rubies, emeralds, sapphires, topaz (color blocks) to fix the grid and enter the central locker.

3.1 Each team has to build two robots- one Autonomous Robot(Robot A) and one Manual Robot(Robot M) for completing the challenge.

3.2 Tasks of robot A:
3.2.1 The robot must navigate from the starting zone to the jewel grid.

3.2.2 It must shift every jewel (color blocks) to its correct location to fix the grid.

3.2.4 It must convey the correction of grid to robot M.

3.2.5 It must cross from the grid following the correct color path to secure the final zone for robot M.

3.3 Tasks of robot M:
3.3.1Once the robot A conveys that it has fixed the grid, robot M will carry out its tasks to fix the remaining parts of the grid.

3.3.2 It should collect the jewels and place it correctly to fix the remaining grid.

3.3.3 If the robot A has successfully entered the final zone, robot M must collect the diamonds and navigate to the final zone.

3.3.6 The robot M must accomplish the game by stacking diamonds in the final zone.

4. PROCEDURE

4.1 Each team has to build two robots- one Autonomous Robot Robot A and one Manual Robot Robot M for completing the challenge.

4.2 Tasks of robot A:

4.2.1 The robot must navigate from the starting zone to the jewel grid.

4.2.2 In the jewel grid, it must go to the sub-grid 1 and detect the jewel placed in the sub-grid.

4.2.3 It must then shift the color jewel to its corresponding color square.

4.2.4 It must indicate the successful shifting of the jewel by blinking an LED.

4.2.5 It should then move to the other three sub-grids and repeat the same procedure (4.2.2 to 4.2.4).

4.2.6 It must cross from the grid to the final zone by following the color line with the color same as that of the jewel which it detected last. (The last sub-grid need not be sub-grid 4)

4.2.7 The robot A cannot enter the final zone if the opposite team's robot A has already reached the final zone.

4.3 Tasks of robot M:

4.3.1 Only after the robot A successfully shifts the jewel to its correct place and indicates it indicates the first correct and successful shift of jewel by blinking LED, the robot M can leave its starting zone.

4.3.2 It must pick up the color jewels corresponding to the remaining three color squares of that sub-grid from the pickup zones.

4.3.3 It should place the corresponding color jewels on the remaining three color squares only in that sub-grid.

4.3.4 It must repeat procedure (4.3.2 and 4.3.3) for a sub-grid once robot A indicates successful shift in that sub-grid by blinking an LED.

4.3.5 Robot M must pick up the diamond and navigate to the final zone.

4.3.6 It should place the diamond in the center of final zone. The jewels should be stacked. It can place the jewels in the final zone only if robot A of its team has reached the final zone.

4.3.6 The robot M must indicate successful accomplishment of the game by stacking all the diamonds in the center of the final zone.

5. SCORING

Task Completed	Points awarded
Robot A	
Navigating to a sub-grid	20
Shifting jewel to the correct square	35
Indicating task accomplishment by blinking Led	10
Navigating through the correct color line	40
Robot M	
Picking up a correct color jewel	10
Placing a jewel in correct square	10
Picking up diamond and reaching the final zone	10
Stacking a diamond in the final zone	15

6. VIOLATIONS

6.1 Any part of the robot M should not enter the sub-grid unless robot A has accomplished its task in that sub-grid.

6.2 The operator cannot enter the jewel grid and the final zone.

6.3 The operator shouldn't disturb the arrangement of the jewels in the jewel grid.

6.4 For every violation, the team responsible shall have to take a restart from the last checkpoint.

6.5 Operator should not touch robot other than at the time of retry.

7. PENALTIES

Case	Points Penalty
Damage to arena	-10
Operator hits the jewels intentionally	-10
Operator pulling the bot intentionally using wires	-10
Robot going outside the arena	-10

NOTE: Penalties will be given by coordinators and coordinator's decision will be final.

8. RETRIES

8.1 In case of any technical issues in any of the robot, the robot can be taken to the boundary of the arena with the consent of co-ordinators.

8.2 A retry can be opted at any time in the match. This retry can be opted for as many times as necessary without any penalty.

8.3 The referee needs to be informed before going for a retry.

8.4 All retries should be from the last checkpoint.

9. ROBOT SPECIFICATIONS

9.1 Each team shall use only one manual robots and one autonomous robot.

9.2 Maximum dimensions of the robots at the start of the game are **300mm x 300mm x 300mm.**

9.3 The robots can extend after the start of the match.

9.4 Maximum allowable weights of the robots combined are **20 kgs**.

9.5 The robots must not use ready-made parts and shall be designed and constructed by the students themselves, failing which the team will be disqualified.

9.6 Manual robot has to be operated by means of cable connection. The length of the cables should be at least 2 m. Wireless radio control is also permitted.

9.7 The robots can be powered with eliminator or a DC battery. The maximum voltage between any two points should not exceed 12V.

9.8 Hydraulics or chemical energy should not be used for any mechanism.

9.9 Pneumatics can be used and in case of use the pressure should be less than 6 bars.

9.10 If a team is using LiPo or Li-ion batteries, it is the team's responsibility to make sure there is no risk involved in its usage.

9.11 The bots shouldn't exceed the dimensional and weight constraints mentioned above.

10. RULES AND REGULATIONS

10.1 The Game is a two way match in which two teams compete simultaneously.

10.2 Each trial lasts for 5 minutes.

10.3 At the end of 5 minutes game will be ended by a blow of whistle.

10.4 1 minute shall be provided for setting up of Robots before the match.

10.5 Only one team member will be allowed to enter the game arena .

10.6 Only one team member is allowed to control the robot. The manual robot operator can walk on the arena but should not disrupt any part of the arena and other the opponent team.

10.7 The robots shall be placed in their respective starting zones at the beginning of the match.

10.8 A robot cannot split into two or more subparts. Subpart implies a robot which has a drive mechanism of its own.

10.9 The autonomous robot must have a Master Power Switch -an easily accessible and visible switch to on-off the robot.

10.10The autonomous robot can start only by switching on the Master Power Switch. No other kind of triggering will be entertained.

10.11 In case of autonomous robot, no communication should be sent to robot after switching on the Master Power Switch.

10.12 The operators are allowed to touch their corresponding robots only during a retry & before the match starts.

10.13 All the statements written in this Problem Statement form the official framework of the rules to be followed by the teams. Violation of any statement in the Problem Statement may lead to disqualification.

10.14 Damage to arena is unacceptable and will lead to instant disqualification.

10.15 The robot exceeding the weight constraints shall be disqualified.

10.16 Referees have all rights to ask the teams to produce the additional explanations on design issues.Also the referees can ask for additional explanation on the safety of the bots if required anytime during the event.

10.17 Participating robots will be checked and tested, according to these rules and regulations.

NOTE :

1) Game field dimensions are subject to a tolerance of ±5 %. No tolerances will be given in case of maximum bot dimensions.

2) The authenticity of any action not provided in this problem statement shall be subject to discretion of Coordinators.

3) Problem Statement, rules and regulations, and scoring pattern may be changed and the changes will be updated on Shaastra website. Participants are responsible to keep themselves updated about the changes. Keep visiting Shaastra website www.shaastra.org for any updates regarding the event.

4) For any queries please mail to robotics@shaastra.org with the subject 'Auto_Query- <query description>'