BEHIND THE ENEMY LINES

Overview:

A leak from a highly reliable source hints us of a possible presence of nuclear warheads in the enemy territory. The location is completely camouflaged and almost invisible to the eyes of our satellite. After the assimilation of lot of data, the approximate coordinates of the major targets were traced. It is also feared that the base is full of landmines.

The Task:

The task can be divided into two main stages:

1. ***Locating the targets:*** You will be given an image, which will highlight the targets. You will have to calculate the coordinates of the targets in this image.
2. ***Destroying the targets:*** With the help of the overhead camera, travel to the coordinates as in the image and destroy them. Avoid moving over the landmines and laser maze.

NOTE:

- ***The targets will be present only in the image and will not be physically present in the arena.***
- ***The landmines and the laser maze will be present only in the arena and WILL NOT be present in the image.***

Image specifications:

(This is the image which would be given during the start of the play)

1. The image will be of jpeg/gif format.
2. The resolution of the image will be 320 x 240.
3. The background color of the image is white.
4. There are will be 5 colors present in the image and each color identifies the target type. The following color will be present:

   a. RED : Surveillance Room
   b. GREEN : Power Substation
   c. YELLOW : Nuclear Warhead Assemblage Room
   d. PINK : Nuclear Warhead Storage Place
   e. BLUE : Nuclear Warhead on Launch Pad

5. There will be one each of surveillance room, power substation, nuclear warhead assemblage room and nuclear warhead on launch pad. There will be multiple nuclear warhead storage places.
6. Every target is represented by 10 x 10 squares of the corresponding colors.
7. The colors in the image will be uniform, subjected to the tolerance of the image format encoding.

Arena Specifications:

- The arena will be a non-reflective surface on top of a wooden base.
- An overhead USB camera with a 2 Mega Pixel resolution will be provided. The drivers for the camera will be provided before the competition.
- The position of the camera with respect to the arena will be fixed.
- The background color of the arena will be ***brown***.
- The landmines will be present in the arena as ***blue*** colored ***circles*** of ***diameter 7cm.***
- The arena will not contain any other color.
- There would be a laser maze present on the upper half of the arena which on solving reaches you to nuclear warhead on launch pad.
- The laser maze would be made of lines of 4cm thickness and are colored in ***blue***.
- The dimension of the arena will be 320cm x 240cm.
    - The dimensions of the laser maze will be 70cm x 240cm.

(For further clarity on laser maze refer figure)

NOTE:

- ***You will not be permitted to use any other camera other than the one provided by us.***
- ***Neither the camera nor the arena will be moved under any circumstance.***
- ***There would not be any land mines in the laser maze.***

Robot specifications:

1. The bots must be within the dimension of 25cm x 25cm.
2. The potential difference between any 2 points in the robot must not exceed 12V. However a tolerance of 2V will be considered due to battery overcharge.
3. The robots are allowed to communicate with a computer outside the arena either wired or wireless. In case of wired link the wire must be slack at every instant of the trial and must come out from the highest point of the bot.
4. Use of on-board sensors/ camera is not allowed.
5. The robots ***must*** have an integrated ***buzzer*** for indication purposes.
6. Use of the following soft wares for image processing is allowed:
   a) Open CV
   b) VC++
   c) Matlab
   d) Scilab

NOTE:

- ***In case you want to use any other software, you MUST first confirm with the coordinators if the use of the software is permitted or not.***

- ***In specific use of soft wares like roborealm, which come with readymade image processing codes/ GUIs is <u>strictly prohibited</u>***
- ***For programming microcontroller(in case you are using one for communicating with the computer) you are free to use any software***

Game procedure:

1. You will be given a setup time of 5 minutes, within which you will have to setup the robot, communication links, calibrate the RGB values of the land mines and the robot top.
2. After the setup is done, you will be given the RGB values of the targets in the image will be given. Once you are ready to start, the image will be copied to a location. You are required to start immediately after the copying the image.
3. Using the given image you will have to map the coordinates of the targets on the arena and move to them in the following sequence:
    i. Surveillance room
    ii. Power substation
    iii. Nuclear Warhead Assemblage Room
    iv. Nuclear Warhead Storage Place
    v. Nuclear Warhead on Launch Pad

NOTE:

- ***After traversing through the first three locations, you can go to the Nuclear Warhead Storage Places in any order.***

- ***You are supposed to traverse to the Nuclear Warhead on Launch Pad only after traversing through all the targets.***
- ***While moving towards the targets you must not move over the mines. Every time your robot steps over a mine, a violation of type1 will be called.***
- ***While moving to the final target you must not move over the laser beam lines. You can move only through the gaps in the laser maze. Every time your robot steps over a beam, a violation of type2 will be called.***

(For the list of violations and penalties see Violations & Disqualifications Section)

- ***After reaching every location the buzzer must sound. If the buzzer is not sounded then task will not be considered.***

Violations & Disqualifications:

A violation will be called under the following circumstances.

Type1 violations:

- This type of violation will be called if any part of the robot moves over a land mine.

Type 2 violations:

- The robot does not enter the laser maze through the gap.
- The robot moves over a laser beam line.

Type 3 violations:

- The robot does not do the tasks in proper sequence.

The following circumstances will lead to disqualification:

- The robot tries to damage the arena.
- The robot dismantles in the arena.
- Any team member enters the arena during the trial.
- The robot is pulled with the wire during the trial.
- An external signal is given to the robot.
- Unapproved software is used.

In case of a violation points will be deducted and in case of disqualification, the trial will not be considered at all.

Penalties:

Type1 violations will cause loss of points as follows:

Movement of the robot over the land mines would result in penalty of 100 points for each of the landmines.

Type2 violations will cause loss of points as follows:

1. Each encounter with the laser beam line inside the maze would result in loss of 200 points.
2. In case the robot does not enter the maze through the bottom opening, no points will be awarded for reaching the target.

Type3 violations will cause loss of points as follows:

In case the targets are not reached in the sequential order then, for every target reached which is not the correct sequence, only half of the points will be added.

Illustration: If the travels in the order 1-4-2-3. Then for the target 1, 300 points will be awarded. However target 4 not being in the proper sequence will fetch only 300 points. Similarly target 2 also will fetch only 200 points. However the 2-3 transition being in correct sequence will fetch complete 500 points.

Event format:

- The event will be conducted in two stages.
- Teams which qualify for the prelims (first stage) will be asked to compete among themselves in the final round (second stage).

Prelims:

- Every team would be given two trials, each trial longing for 8 minutes, which includes the set up time of 5 minutes and play time of 3 minutes.
- The better of the two trials in terms of scoring will be considered.

- For prelims the participants need not go through the laser maze. There would not be any target placed in the maze, and no extra points will be awarded for traversing through the maze.

Finals:

- Each team will be given two trials, each longing for 10 minutes, which includes setup up time of 5 minutes and play time of 5 minutes.
- The better of the two trials in terms of scoring will be considered.
- In the finals the laser maze will have to be traversed and there would be target/targets placed in the maze. The points will be awarded according to the scoring criteria.

Selection Procedure:

- The selection to the prelims at Shaastra would include TDP (team description paper) which should contain the team particulars, algorithm and code/pseudo code used to merge the two images and the path generation, which should be submitted by the given dead line which would be 3 or 4 weeks before the event.
- The template for the TDP's will be shortly up on the website.
- The images on which the processing is required for TDP will be released shortly.

- The rules and regulations to be followed in writing a team description paper (format and other considerations) will be given in the rules and regulation section of robotics on the website.

Tolerance:

- Every dimension that is used in describing the arena is subjected to a tolerance of 5%.

Scoring Criteria:

1. Reaching targets 1, 2, 3, 4, 5 will fetch 300, 400, 500, 600 and 1000 points respectively.
2. Points for reaching the target will be added only once. In case you re-visit a target, no extra points will be awarded.
3. Each crossing of laser beam line would fetch 300 points.(Further clarification refer to figure)

Scoring Formula:

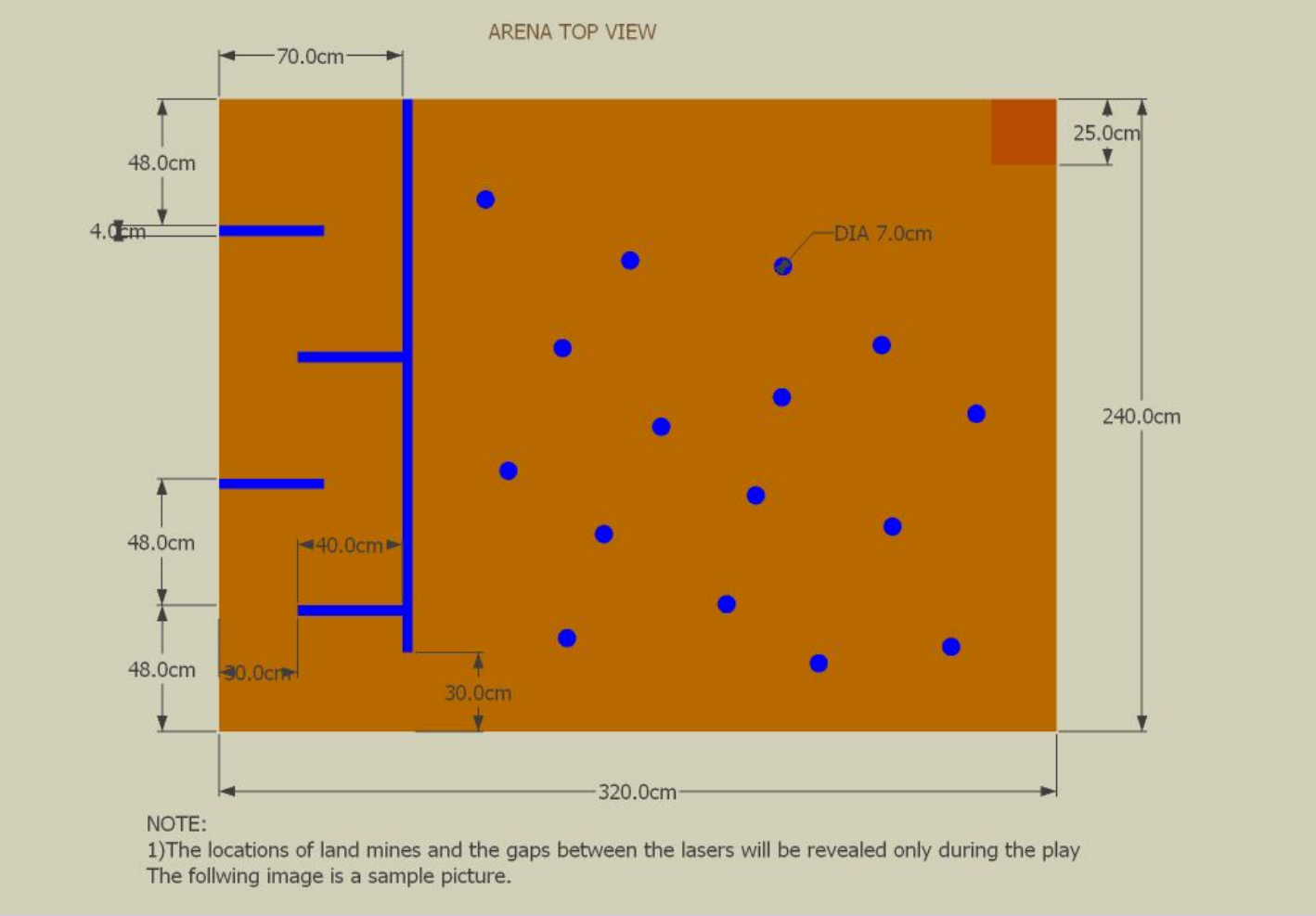
(Time left in minutes) 200+ (target1)*300+ (target2)*400+ (target3)*500 + (no of target4s)*600+ (target5)*1000+ (no of laser beams crossed)*300+ (type1 penalties) + (type2 penalties) + (type3 penalties).*

- *Target1, target2, target3 & target5 will take value'1'when reached and '0' if not reached only when the sequence is followed, if the sequence is not followed scoring will be according to the illustration in penalty of type 3.*

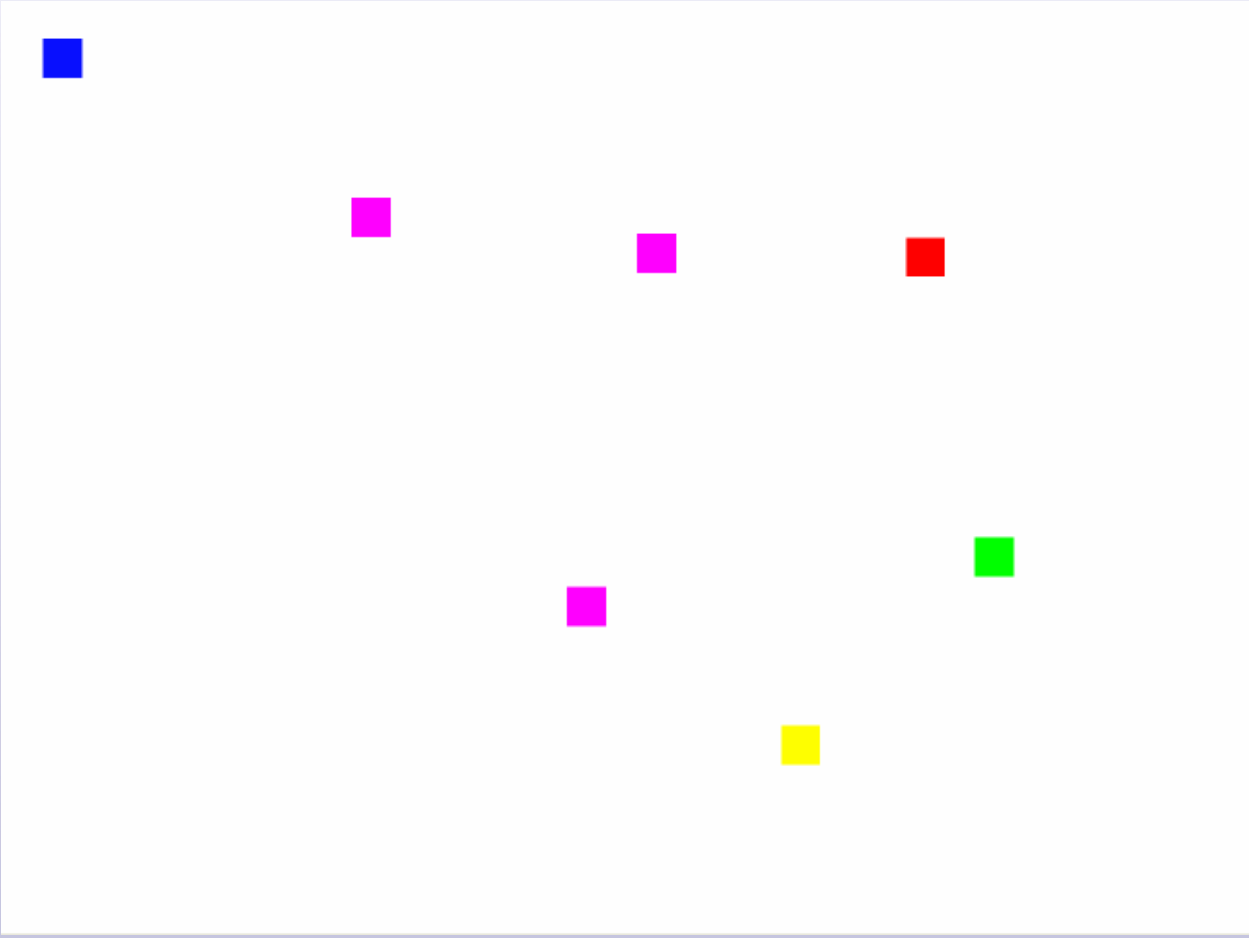
IMPORTANT NOTES:

1. ***The image will be given only during the start of the play.***
2. ***The RGB values of colors will be mentioned shortly.***
3. ***The gaps between the laser lines and the position of land mines shown in the arena are all samples. The actual positions of land mines and gaps between the laser lines are revealed only at the start of the play.***

4. ***Please find attached the following attachments in the zip file:***
   - ***Arena top view.(2D model)***
   - ***3D model of the arena.***
   - ***Sample image containing the targets.***
   - ***Image containing the targets mapped with arena.***
   - ***Top view of the actual arena.***
   - ***A file containing the links and tutorials for image processing.***



NOTE: The 25x25 sq.cm square represents the start position of the robot.



NOTE:

- The RGB values of the targets will be released shortly.
- The size of each square is 10x10 sq.cm.