CUHK Robotics Team

Robot Design Contest 2023

Preliminary round: 25-26 Oct 2023 18:30 – 21:30

Elimination round: 27 Oct 2023 18:30 – 22:30

Game Rules

Version 2.1, Updated on 27 Sep 2023

Log of Changes

Version 2.1

- 1.3 Terms and definitions “Scoring criteria”:
  For Gulping Zone: The Soft Drink Can is standing upright and at least part of the orthogonal projection of the Soft Drink Can is inside GZ.

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1. Introduction

1.1. Background

CUHK Robotics Team Robot Design Contest is organized by CUHK Robotics Team as a part of the new member training and selection process. The contest was introduced in 2023 to enhance ideation, practical knowledge, and hands-on skills to better prepare new members for handling more complex tasks in the preparation for the annual Robocon Contest.

All members of the new member training shall participate in this competition in groups of 3-4. Teams are required to make use of their creativity, engineering and technological knowledge to design and build robots in accordance with the competition rules using specific materials and production methods. There are also additional support sessions and resources to supplement new members with basic skills.

1.2. Game field

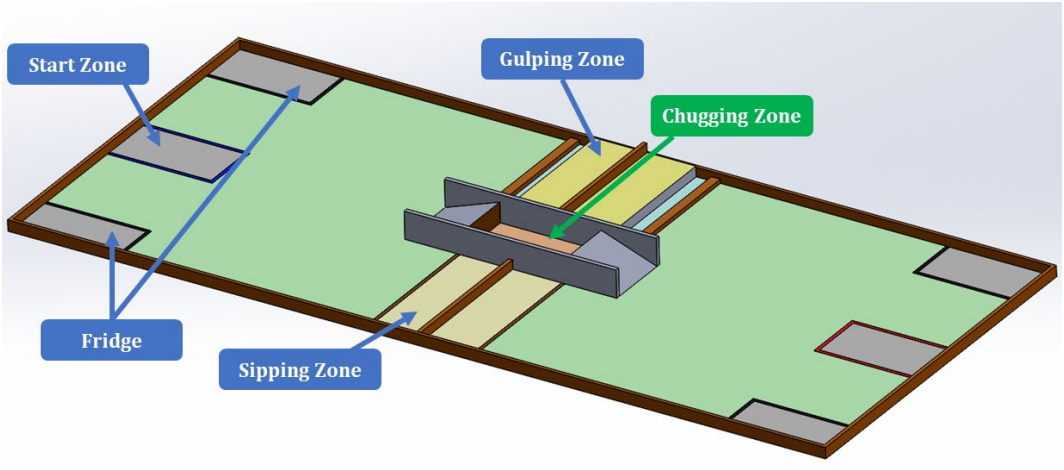

Figure 1 Overview of game field

The game field comprises of Red Team area and Blue Team area, and a Chugging Zone which is shared between two teams. Each of Red Team area and Blue Team area comprises of a Start Zone, two Fridges, a Sipping Zone, a Gulping Zone, a ramp, barriers, and space for the team's robot to move in.

Colours of the areas used in the diagram are only for easy illustration. Additional drawings of the field are provided in a separate section of the document. However, the dimensions are for reference only and please refer to the actual game field set up in the laboratory.

1.3. Terms and definitions

Terms and definitions used in the rules of CUHK Robotics Team Robot Design Contest 2023 are as follows:

No.	Term	Definition
1	Team	There are two teams, Red Team and Blue Team.
2	Stressed Engineer (SE)	Each team builds one robot named Stressed Engineer (SE), which picks up Soft Drink Cans and bring them to Sipping Zone, Gulping Zone and Chugging Zone.
3	Start Zone	Start Zone is the area where SE stays within to start the game. It is also the Retry Zone when SE retries. The surrounding tape is not considered part of the Zone.
4	Soft Drink Can	Soft Drink Cans are the objects that SE need to bring to Sipping Zone, Gulping Zone and Chugging Zone. If a Soft Drink Can touches any area out of the game field, it cannot be used again. A Soft Drink Can is an open empty standard 330ml aluminium can, with an outer diameter of 66mm and height of 116mm.
5	Fridge	Fridge is the area where Soft Drink Cans can be placed before the start of the game. The surrounding tape is not considered part of the Fridge.
6	Sipping Zone (SZ)	Sipping Zone is level with the teams' area. The surrounding tape is not considered part of the Zone.
7	Gulping Zone (GZ)	Gulping Zone is elevated 50mm from the teams' area.
8	Chugging Zone (CZ)	Chugging Zone is level with the teams' area.
9	Ramp	Ramp is the slant surface next to Chugging Zone.
10	Scoring criteria	A Soft Drink Can is considered inside the area if: *For Sipping Zone:* Orthogonal projection of the Soft Drink Can is completely inside SZ. *For Gulping Zone:* The Soft Drink Can is standing upright and at least part of the orthogonal projection of the Soft Drink Can is inside GZ. *For Chugging Zone:* At least part of the orthogonal projection of the Soft Drink Can is inside CZ.
11	Great Diabetes	Great Diabetes is achieved when a team completes stage III. The game will be ended.

2. Game procedures

The game time is 3 minutes.

2.1. Set up

2.1.1. Before the game starts, each team is given 20 Soft Drink Cans for their team.

2.1.2. The team will be given 1 minute for setting up, including moving Stressed Engineer (SE) to the Start Zone, and putting the Soft Drink Cans in their Fridges.

2.1.3. The set-up time will start right after the signal from referees is given and will end right after 1 minute.

2.1.4. If a team fails to complete the setting within the given time, they can resume setting after the start of the game after obtaining the referee's permission. Once they finished setting, they can start their robots with the referee's permission.

2.1.5. Before the game starts, the robot must be completely within their respective Start Zone, including its space above. The controller should be placed on the ground clearly visible to the referee.

2.1.6. The team can freely allocate the Soft Drink Cans in their Fridges during setting up time. At the end of the setting up time, the orthogonal projection of all Soft Drink Cans should be completely within their Fridges.

2.1.7. Teams are allowed to use a jig to place their Soft Drink Cans. However, at the end of the setting time, only Soft Drink Cans should remain in the Fridges.

2.1.8. When the setting time has passed, the game will start.

2.2. Robot and team members during the game

2.2.1. SE can enter all of their teams' areas and zones in the field, but the wheels of SE are not allowed to touch the Ramp.

2.2.2. SE and Soft Drink Can(s) held by SE are prohibited to enter the opponent team's area, including the airspace above.

2.2.3. Team members are not allowed enter the game field except during a retry.

2.2.4. Team members must not touch SE except during a retry.

2.2.5. Team members must not touch any Soft Drink Cans except during a retry (see Retry section for details).

2.2.6. Stressed Engineer (SE) or Soft Drink Can of the team cannot cause a Soft Drink Can of the opponent team to leave the Fridge or scoring position.

2.3. Task of Stressed Engineer (SE)

2.3.1. Stressed Engineer (SE) picks up Soft Drink Can(s) from the team's Fridge.

2.3.2. There are different Stages for Stressed Engineer to place Soft Drink Can(s) onto Target Zones, starting from Stage I. Referee signal indicates completion of the stage upon reaching the Target (determined according to "scoring criteria" in Section 1), and the team proceeds to the next stage.

	Target Zone(s)	Target
Stage I	Sipping Zone (SZ) only	6 Soft Drink Cans of the team in Sipping Zone
Stage II	Sipping Zone (SZ) and Gulping	4 Soft Drink Cans of the team

	Zone (GZ) only	in Gulping Zone
Stage III	Sipping Zone (SZ), Gulping Zone (GZ) and Chugging Zone (CZ)	10 Soft Drink Cans of the team in Chugging Zone

Any Soft Drink Cans placed onto a Zone not for that Stage will not be considered and cannot be reused.

2.3.3. Stressed Engineer (SE) can pick up the Soft Drink Can(s) which have fallen in the field, provided that the action does not violate other rules.

2.3.4. Great Diabetes is achieved when a team completes Stage III.

2.4. End of the game

The game ends when any of the following conditions are met:

- The game time of 3 minutes is over.
- One of the teams has achieved Great Diabetes.
- When either team is disqualified.

2.5. Deciding the winner

The result is decided based on the locations of the Soft Drink Cans at the end of the game. Only Soft Drink Can(s) that fulfills the "Scoring Criteria" in Section 1 will be considered.

The Winning Team is determined in the following order:

a) The team who achieves "Great Diabetes" wins the game.

c) The team with more Soft Drink Cans on Chugging Zone (CZ) wins.

d) The team with more Soft Drink Cans on Gulping Zone (GZ) wins.

e) The team with more Soft Drink Cans on Sipping Zone (SZ) wins.

f) The team completing Stage II in a shorter time wins.

g) The team completing Stage I in a shorter time wins.

f) The team with a lighter weight of Stressed Engineer (SE) wins.

g) If there is a tie, the Panel of Judges will decide the winner.

2.6. Retry

2.6.1. When the teams want to adjust the robot, the team can apply a "Retry" to the referee.

2.6.2. There is no limitation for retry. A retry is governed by the rule with approval from the referee.

2.6.3. Team members must place Stressed Engineer (SE) in the Start Zone while preparing for a retry.

2.6.4. During a retry, team members can adjust the positions of Soft Drink Can(s) that are in contact with Stressed Engineer (SE) at the time of retry. The team can also return these Soft Drink Can(s) to a Fridge of the team.

2.6.5. Team members can remove Soft Drink Can(s) from the team's area. These cans cannot be used again.

2.6.6. Stressed Engineer (SE) must start from Start Zone after a retry. All the ground contacts of SE must be within the Start Zone.

2.6.7. A retry is finished only after obtaining permission from the referee.

3. Violations

The team who commits the following shall be deemed to be in violation of the rules and subject to amandatory retry:

3.1.1. Any part of Stressed Engineer (SE) or Soft Drink Can held by SE enters the opponent's game field including air space above the game field.

3.1.2. Any wheel of Stressed Engineer (SE) touches the Ramp.

3.1.3. Stressed Engineer (SE) or Soft Drink Can of the team cause a Soft Drink Can of the opponent team to leave the Fridge or scoring position.

3.1.4. A team member touches Stressed Engineer (SE) without the referee's permission.

3.1.5. Any other acts deemed to be an infringement on the published rules of the game.

4. Disqualifications

If a team is deemed to have committed the following acts intentionally, the team should be disqualified for that game:

4.1.1. Any acts that pose danger to the game field, its surroundings, the robots, the participants, officials and public.

4.1.2. Any other act that goes against the spirit of fair play.

4.1.3. Any act of disobedience against the referee's warning or decision.

5. Robot

The robot used in the contest must comply with the regulations below:

5.1. General regulations

5.1.1. Each team is allowed to use 1 robot to participate in the contest.

5.1.2. The robot must not split into parts, intentionally or unintentionally, during the game.

5.2. Robot materials

5.2.1. A set of mecanum chassis is provided for each team. Teams are not allowed to modify the chassis.

5.2.2. A set of electronics is provided for each team.

5.2.3. A wireless controller is provided for each team.

5.2.4. Each team can use a maximum of 4 actuators, from a free combination of servos and pneumatic cylinders.

5.2.5. Each team will be provided with a set of 3 pieces of batteries.

5.2.6. Apart from the provided materials, teams are allowed to use aluminium parts, acrylic, screws and nuts, brass columns. Note that 3D-printed part is not in the list.

5.2.7. Any use of materials not listed is subject to case-by-case approval by the instructor or core members.
5.2.8. 20 push-ups (witnessed by core members) are required as penalty for each part that requires replacement.

5.3. Robot production

5.3.1. The robot must be built by the Team.
5.3.2. For safety reasons, new members can only enter the lab or use any tools when there are core members or instructors present.
5.3.3. The normal office hour for production is 09:30 to 18:30 (lab closure during lunch break) on working days, subject to further notice. Special appointments with core members can only be arranged on a merit basis.
5.3.4. For aluminium parts, milling machines cannot be used. Teams can process the parts manually.
5.3.5. For acrylic parts, teams can submit suitable files for laser cut by core members. Acrylic of 3mm and 5mm are available. Please refer to separate section for submission link and file naming requirement. Each request must be within 250mm x 250mm in size. Only requests that comply with the instructions (see separate training video) will be processed and be available for collection after 14:00 on the day after the cut off time. Requests that do not comply with the instructions will not be entertained and will not receive individual notice. Additional requests are subject to merit basis.
5.3.6. For batteries, a voltage display unit must be used while using any battery. Do not let the voltage of any individual cell drop below 3.7V (i.e. total 7.4V for 2S battery, 11.1V for 3S battery). Remove the voltage display unit after use. A battery recharge box will be available next to the robot storage area. Batteries inside the recharge box will be recharged at least once a day on working days and will be delivered back to your locker after charging.
5.3.7. All materials are properties of CUHK Robotics Team and cannot be taken away from the robotics labs. Storage areas will be allocated for teams.

5.4. Robot size

5.4.1. The robot (including the controller and its cable) must fit into the Start Zone of 450mm length x 270mm width. There is no height limit.
5.4.2. The robot must not exceed the regulated 600mm length x 600mm width throughout the game, excluding the wired controller if any.
5.4.3. The length of the wire of the controller, if any, must not exceed 2500mm.

5.5. Robot weight

5.5.1. The total weight of the robot, which includes battery, controller, and its cable, must not exceed 5 kg.
5.5.2. Back-up batteries, which are of the same type as above, are exempted.

5.6. Power source of the robot

5.6.1. Each team should prepare their own power source for their robot.

5.6.2. All batteries used in the robot, controller and any other devices used during the game should not exceed 12.6V.
5.6.3. The maximum voltage within the overall circuit of the robot should not exceed 36V.
5.6.4. The air pressure used during the game must not exceed 600kPa.
5.6.5. Any power source deemed dangerous will be banned from use.

6. Safety

6.1.1. For safety reasons, new members can only enter the lab or use any tools when there are core members or instructors present.
6.1.2. All robots must be designed and built not to pose danger to anyone, including the team, the opposing team, the people in the surroundings and the venue.
6.1.3. The use of accumulator, lead-acid batteries (including colloidal), power sources that involve flames and/or high temperatures, anything that may contaminate the game field, as well as anything that may cause the robots to break down and/or create a situation that hinders the progression of the contest are prohibited.
6.1.4. Only lasers of class 2 or less can be used, and they must be handled with care to avoid any damage to the eyes.

7. Competition scheme

Preliminary round: 25-26 Oct 2023 18:30 – 21:30 (the usual consultation hours)

Elimination round: 27 Oct 2023 18:30 – 22:30

Location: ERB 108A

The contest consists of two rounds – Preliminary round and Elimination round.

The preliminary round is in the form of a solo demo, in which each team is given 3 minutes to demonstrate their performance without an opponent team. Teams are ranked according to the following order:

a) Teams who achieve “Great Diabetes” rank higher.
b) The team who achieves “Great Diabetes” in a shorter time ranks higher.
c) The team with more Soft Drink Cans on Chugging Zone (CZ) ranks higher.
d) The team with more Soft Drink Cans on Gulping Zone (GZ) ranks higher.
e) The team with more Soft Drink Cans on Sipping Zone (SZ) ranks higher.
f) The team completing Stage II in a shorter time ranks higher.
g) The team completing Stage I in a shorter time ranks higher.
f) The team with a lighter weight of Stressed Engineer (SE) ranks higher.
g) If there is a tie, the Panel of Judges will decide the winner.

The ranking will determine the play-off match sequence for the Elimination round.

The following awards will be given with certificates:

Champion	For the team winning the Finals.
1st Runner-up	For the team losing the Finals.
2nd Runner-up (x2)	For the two teams losing the Semi-Finals.
Best Cost-efficiency Award	For the team who achieves the most with as compared to the amount of resources used.
Best Design Award	For the team with good use of engineering principles in designing the robot.
Best Strategy Award	For the team with well thought-out strategies in the game match.
Best Operator Award	For the team with well control of the robot in the game match.

8. Continuous assessment

During the preparation and competition, members will be closely observed in their working ability, effort and style. Individual members with impressive performance will be approached privately with priority in choosing task in the upcoming season of Robocon. The goal of the contest is not to eliminate any member, but to identify members with significant potential for early communication.

8.1. Open consultation

There are two classes for open consultation. Attendance is compulsory and constitutes part of the continuous assessment. In open consultations, you are welcome to ask any questions regarding the training videos provided, mechanical design or programming of your robot, or any difficulties encountered.

Location: ERB 218

	Open Consultation	Preliminary round contest
Wed 18:30 – 21:30	27 Sep, 4 Oct, 11 Oct, 18 Oct	25 Oct
Thu 18:30 – 21:30	28 Sep, 5 Oct, 12 Oct, 19 Oct	26 Oct

Robot production starts at the first open consultation session. Most materials will be distributed during the session of the respective class.

8.2. Video demo

Apart from observation, there are video demos throughout the course of preparation. Performance in the video demo does not affect the contest scoring but can significantly affect the availability of all resources granted on merit basis.

The time limit for each video demo is 1.5 minutes and a link to the video should be submitted.

Please refer to separate section for submission link and file naming requirement. The deadlines of video demo are as below:

	Deadline	Content
Video demo 1	6 Oct 2023 (Fri) 23:59	Demonstrate basic robot movements as guided in the sample video
Video demo 2	20 Oct 2023 (Fri) 23:59	Proof of concept of own idea, show of basic functionality, anything you want to showcase

9. Others

9.1.1. Interpretation of the rules is subject to the final decision by the Panel of Judges. Common sense, sportsmanship, and ease of judging are generally considered.

9.1.2. For the things not covered in this Rule Book, the teams are required to obey the decisions of the organizers and referees.

9.1.3. Dimensions, weights, etc. of the game field and game object described in this Rule Book mighthave plus or minus 5% of tolerance unless stated otherwise.

9.1.4. Teams are required to obey the decisions of the organizers and referees regarding any safety issue of the robot and/or the people in the vicinity.

10. Additional drawings

The dimensions are for reference only. Please refer to the actual game field set up and game objects in the laboratory.

10.1. Game field

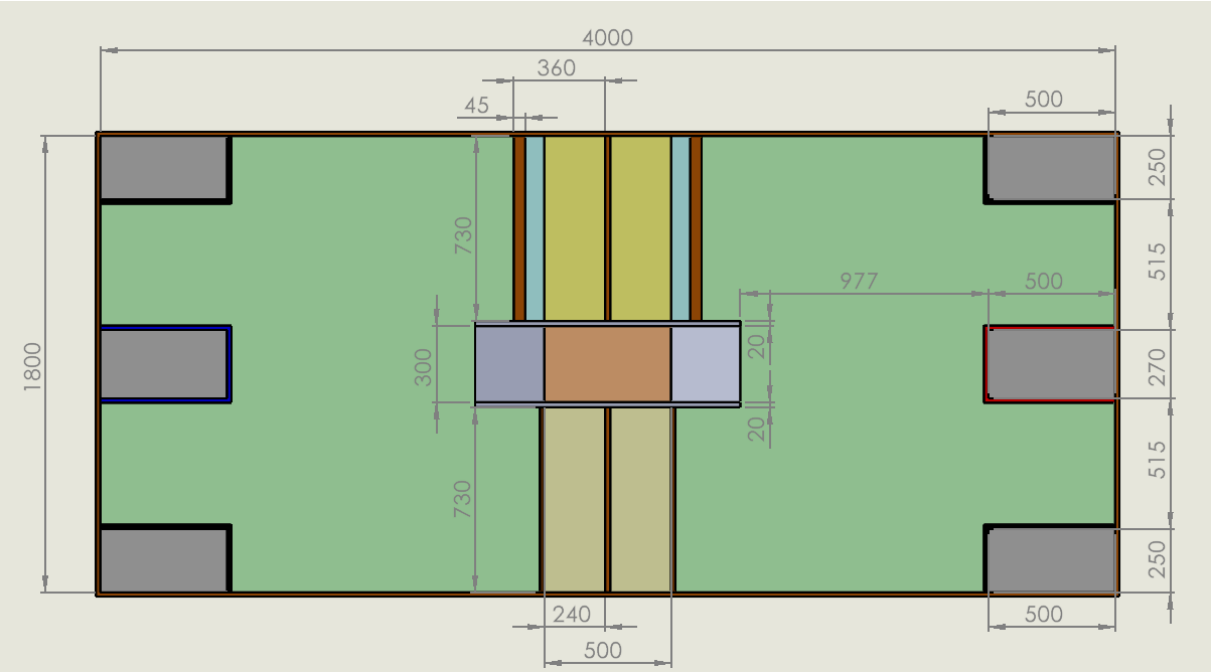

Figure 2 Top view of game field

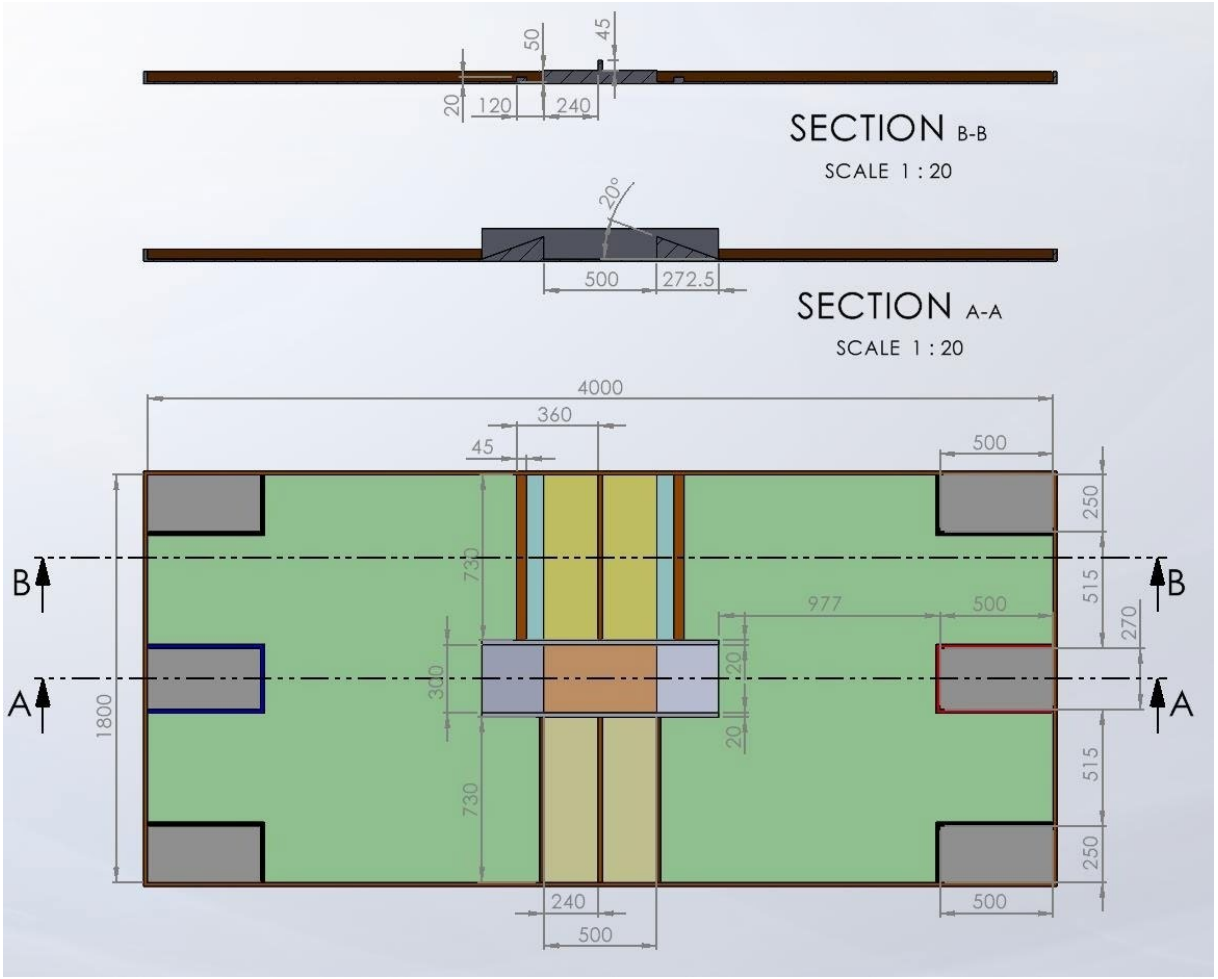

Figure 3 Section view of the game field

10.2. Soft Drink Can

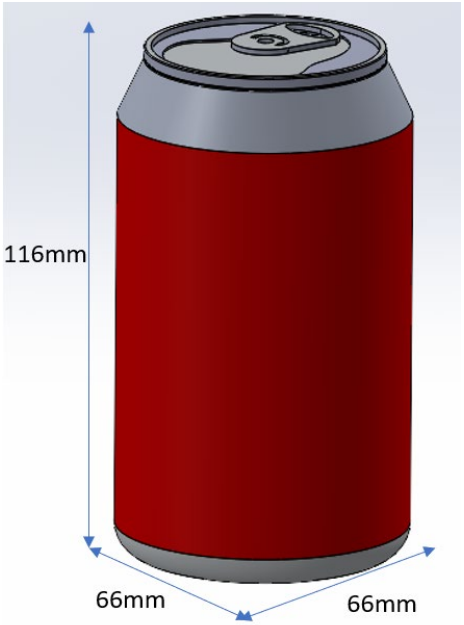

Figure 4 Drawing of Soft Drink Can

11. Important links

Session preference form (By 25 Sep 2023 23:59):

https://forms.gle/mp6oWTVesSJLVWfUA

Laser cut request:

https://forms.gle/Jg35XPi46EYGv2B69

- File naming: "Group[No.]_[Your SID]_[Part Name]_[Thickness]_x[Quantity]" (e.g. Group01_1155123456_Part01_3mm_x1).
- Please follow the instructions in the training video.

Video demo 1:

https://forms.gle/mzHS1GBzUbnaV8dPA

- Video naming: "Group[group no.]_demo_1" (e.g. Group01_demo_1).

Video demo 2:

https://forms.gle/fwAtbpyUVp8nfjyq6

- Video naming: "Group[group no.]_demo_2" (e.g. Group01_demo_2)

Training videos:

https://youtube.com/playlist?list=PLHQwZXN61iHM0kR_CIHdZiQdtW75HrJD-&si=JQygJFDSZXbyBPFo

Sample code:

(Will be provided in Week 2 Consultation Session)

12. Important dates

	Wednesday session	Thursday session
Briefing	20 Sep 2023 18:30 – 20:00	
Indicate session preference	By 25 Sep 2023 23:59	
Open consultation 1	27 Sep 2023 18:30 – 21:30	28 Sep 2023 18:30 – 21:30
Open consultation 2	4 Oct 2023 18:30 – 21:30	5 Oct 2023 18:30 – 21:30
Video demo 1	By 6 Oct 2023 23:59	
Open consultation 3	11 Oct 2023 18:30 – 21:30	12 Oct 2023 18:30 – 21:30
Open consultation 4	18 Oct 2023 18:30 – 21:30	19 Oct 2023 18:30 – 21:30
Video demo 2	By 20 Oct 2023 23:59	
Preliminary round contest	25 Oct 2023 18:30 – 21:30	26 Oct 2023 18:30 – 21:30
Elimination round contest	27 Oct 2023 18:30 – 22:30	