Vcc

Free Fall

V 1.0 – Initial Version for 2025 Season

This file can be found on the **Vcc** page on the Robofest website
Coaches are responsible for communicating rules updates to participants

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1. Vcc Overview

Learning Objectives

- Video image processing
- Shape & Size detection
- Lighting
- Calibration
- Practical Real-World Applications
- Region of Interest (ROI)
- Object identification and reaction

- An Open Category competition, which will take place at the World Robofest Championship
- A unique STEM (Science, Technology, Engineering, and Mathematics) competition with intelligent and interactive robots using vision-based systems to compete

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2. Age Divisions and Team Size

- Age Divisions:
    - Senior Division (Grades 9-12)
    - Winning team receives renewable LTU scholarship
    - Team Size: Maximum five (5) members
- Team Registration Fee: $90 at the World Championship (local events may have an additional fee)
- Teams must review and abide by: Robofest 2025 General Rules
- Each team member must bring the signed Robofest Consent and Release Form on the day of the event, if not completed online

3. Game Scenario: Free Fall

- There is a burning tower that contains survivors and valuable items. You need to keep them separated and catch them with your robot while avoiding fireballs and poison
  - Red = Fireballs (avoid these)
  - Green = Poison (avoid these)
  - Blue = Survivors (catch these in the blue cup)
  - Yellow = Valuable items (catch these in a yellow cup)
- There will be two exit ramps from the building and items will be falling at a random rate of one item every 1-3 seconds
- Only one ball will be released at a time and balls will not simultaneously be released from both ramps
- Game will last approximately 2 minutes. There is no time limit as game ends when the last ball is dropped or team calls for an end of run
- Ejection height will be revealed at the start of each round

3. Game Synopsis

- Robot starts after judge declares "three, two, one, start"

- Release of the balls on the two chutes will be automated and be in a pre-defined sequence and a pre-defined rate. The rate and sequence will be unknown

- Robot needs to catch the blue marbles in a blue cup (or marked "blue")

- Robot needs to catch the yellow marbles in a yellow cup (or marked "yellow")

- Robot must not catch the red or green marbles

- Teams will be given 2 minutes to complete the task

  ▪ Students may only touch the robot to start the competition

  ▪ Judges will not touch the robot

- At the end of the round, score is determined by the contents of the cups

4. Programming Time

- Teams given:
    - Unknown ejection height and separation of the ramps
    - 45 minutes to program
    - During the work-time, no adult/coach's help is allowed
    - Team may be disqualified for receiving illegal help
- After the 45-minute work-time teams must move away from the robot
- Teams will not be permitted to access the internet during the programming time and will not be permitted use of cell phones.

5. Setup

- Lighting conditions at the competition are unknown and possibly dynamic

- Official game table is a 30x72 inch (76x183 cm) table with the tower positioned on the table

- Team will place the robot on the table at the start of the run

- Robot may not touch the tower

- Robot may move but must remain on the table
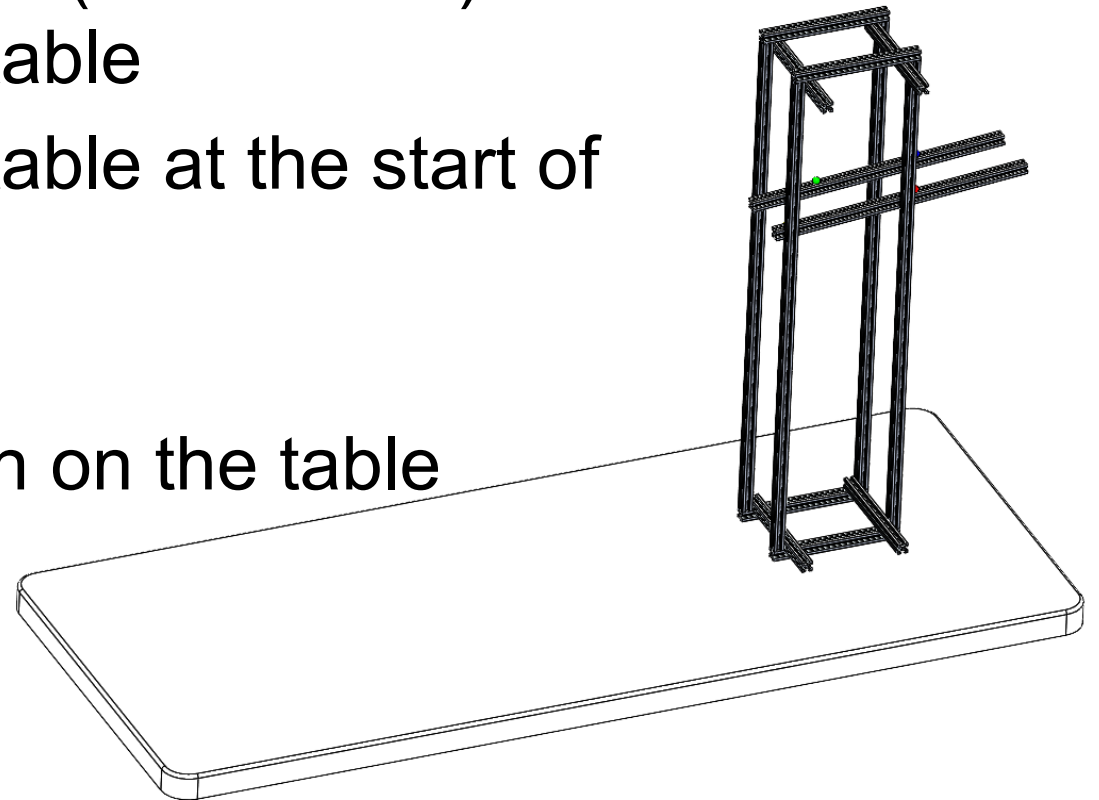
5. Setup (Continued)

- The tower will be placed on the table in approximately the position shown.

- Teams will have approximately 125 cm of open table to position the robot

- Background behind the tower will be against a wall and there will be an attempt to have it be constant

Wall on this side

~125 cm
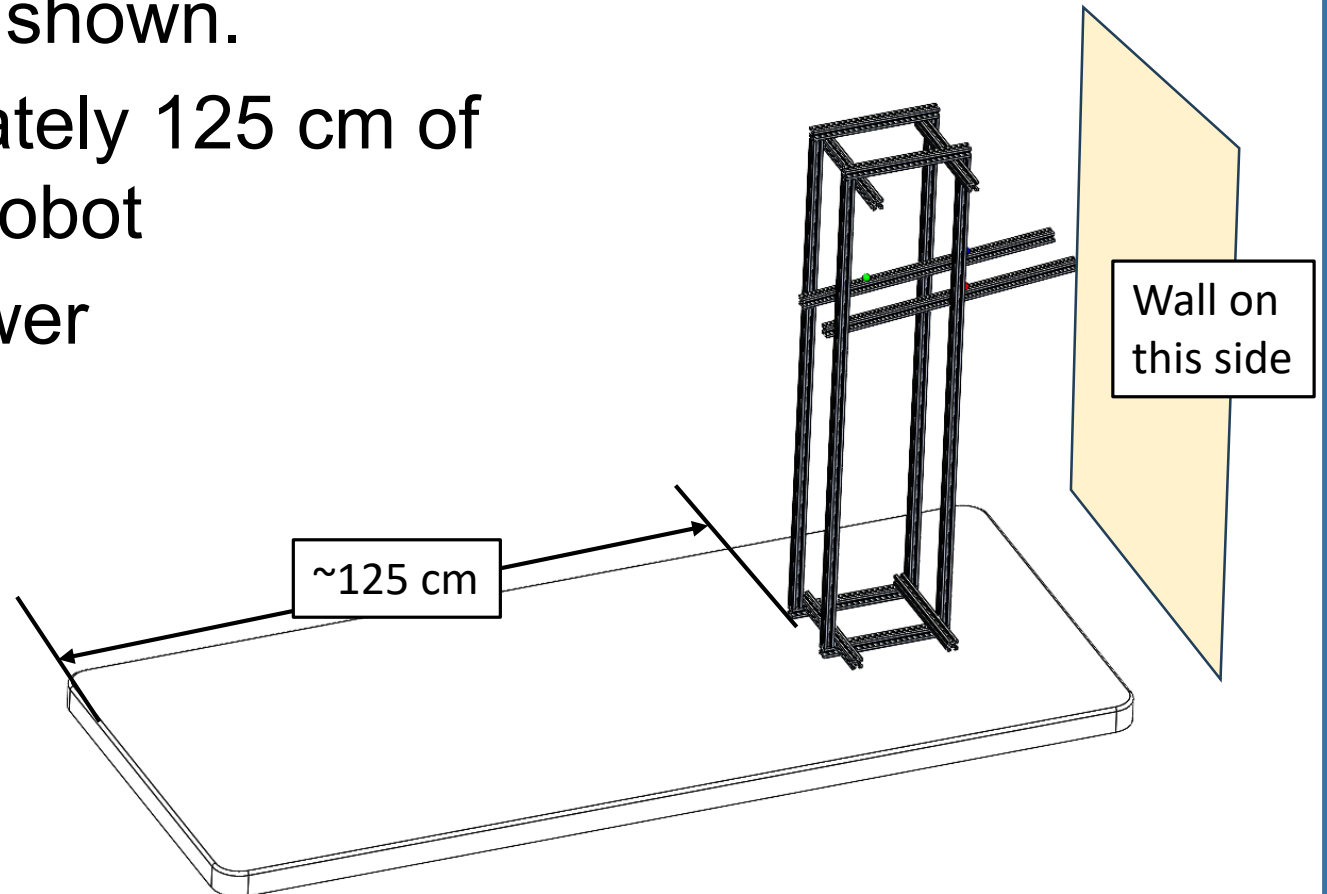
6. The Tower

- Tower can be built with 20x20mm extrusions
- The Tower will have two ejection ports
- Items will be visible for the entire length of the ramp
- Balls will be released automatically
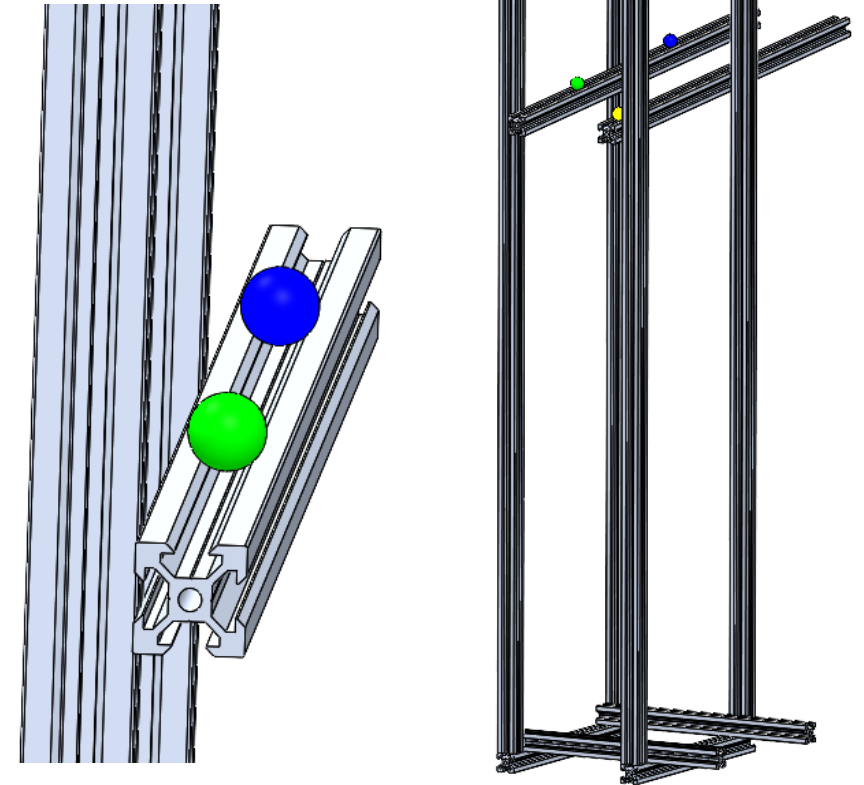
6. The Tower (dimensions)

- A = Rail Spread: 50~175mm
- B = Port Height: 30~80cm
- C = Rail Length: 50cm
- D = Rail Extension: 5~20cm
- The angle of the ramp will be ~2° resulting in a typical roll time in the 2~3 second range.
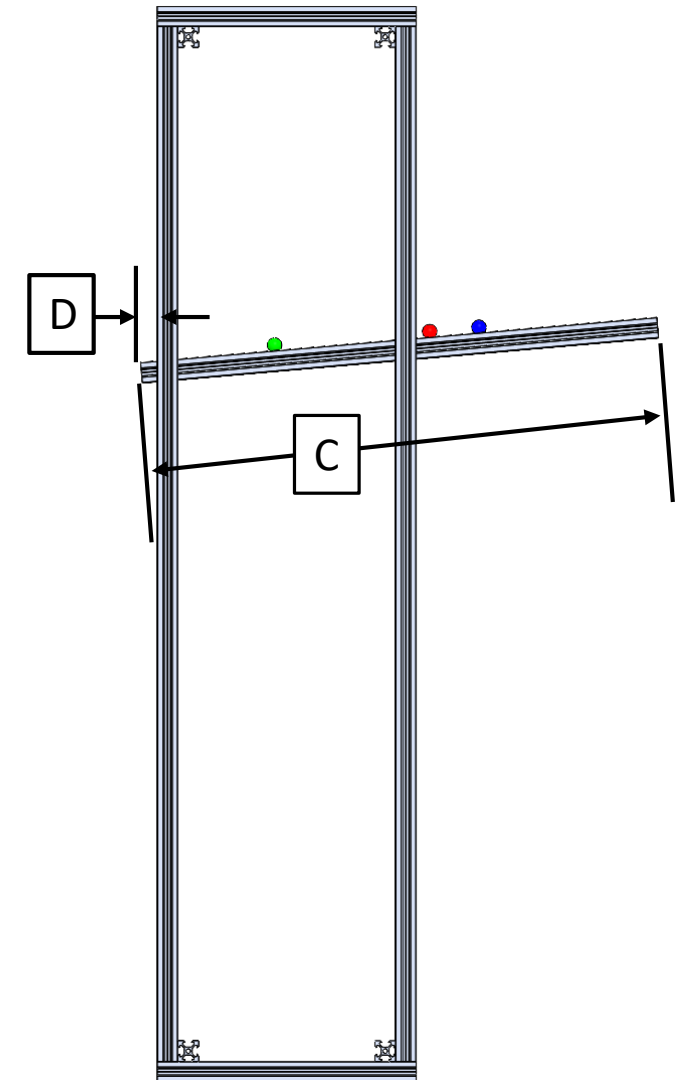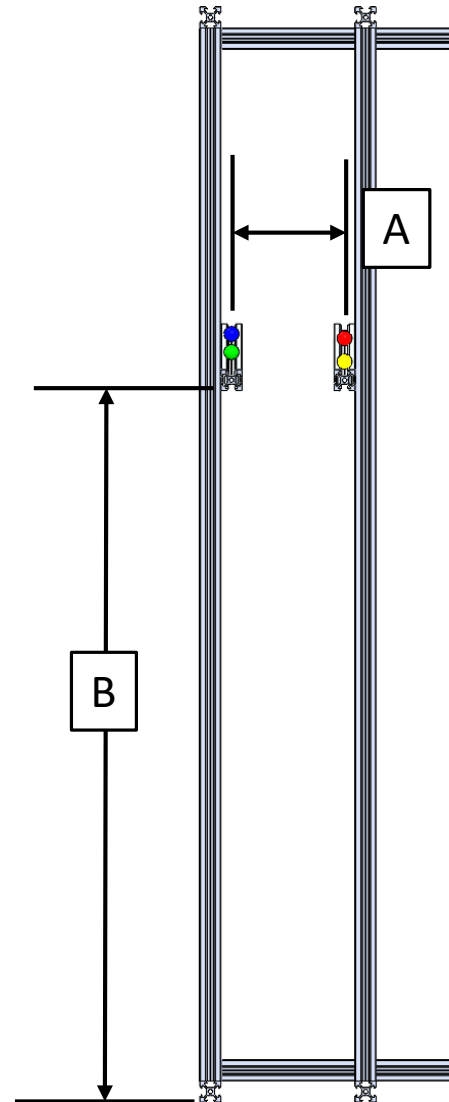
7. The Items

- Items will be 14mm glass marbles

- Amazon item: [Link](#) (Alternates: [Link](#), [Link](#), [Link](#))

- If any of the links are out of stock simply search for "Chinese Checkers 14mm marbles"

- Exact shade of the marbles will be unknown based on variation of the samples

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7. The Cups

- Standard Drinking cups are required

- Amazon item: [Link](#)

- Opening can be a maximum of 100mm

- Each team uses one blue cup for catching the survivors and one yellow cup for catching the valuables

- If cups are not the right colors, it is acceptable to just label the cups

8. Scoring

- Scoring will be done by judges at the end of the round
  - 2 points for each blue and yellow marble caught in the correct cup
  - 1 point for each blue or yellow marble caught in the wrong cup
  - -1 point for each red or green marble caught
  - -10 points for a restart
- Results will be posted when all teams have completed their runs
- Round 2 will proceed the same as round 1 except:
  - The tower parameters and unknown sequence will be different

8. Scoring (Official Score Card)

https://www.robofest.net/images/2425/2025VccScorecard.pdf

Judging Items (to be checked at the end of the run)			Possible Count	Actual Count	Point Value	Score Earned/Lost	max value
#1	Blue Cup Scoring	Blue Balls in Blue cup			2		
		Yellow Balls in Blue cup			1		
		Red Balls in Blue cup			-1		
		Green Balls in Yellow cup			-1		
#2	Yellow Cup Scoring	Yellow Balls in Yellow cup			2		
		Blue Balls in Yellow cup			1		
		Red Balls in Yellow cup			-1		
		Green Balls in Yellow cup			-1		
#3	Restart was requested (restart penalty)		0 1 (no) (yes)		-10		
				TOTAL SCORE Total maximum score = 100			

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8. Scoring (of each round)

Example:

- Team catches:
  - 45 marbles in the correct cup   45 x 2 = 90
  - 10 marbles in the incorrect in cup   10 x 1 = 10
  - 5 wrong marbles   5 x -1 = -5
  - No Restart   = 0
  - Total: 95 points

9. Rules to Determine Winners & Break Ties

- Winners will be decided by average points of 2 rounds
- Tie breakers will be the best score
- 2nd tie breaker will be a rerun

10. Robot Specifications

- Must be completely autonomous. (Any type of remote control by a human driver or remote computer is not allowed.) The main controller can be a laptop, notebook, tablet, micro-controller, open MV, Jetson Nano, or even a smart phone

- Any robot platform with up to 4 cameras is allowed. Must be USB, single lens camera. Any lens is acceptable

- Any programming language may be used

- Width must be less than 24 inches (60.7 cm)

- Length must be less than 36 inches (91.4cm)

- Height must be less than 36 inches (91.4cm)

- Weight: no limit

- Additional sensors may be used

- Additional lighting can be provided by the robot

- The robot may *not* automatically expand its dimension larger than the specified maximum values

- Camera angle: no restriction. You may use motors to move the camera. Wide angle lens can be used

10. Robot Specifications (continued)

- A Robofest team name & team ID tag on the robot are required
- No communication via WiFi or Bluetooth or similar will be permitted
- Top of the cup may not exceed 20cm from the table
- The robot may deflect the marbles and guide the marbles while "falling" as long as the marbles fall continuously into the cup
- If the marble is rolling on the robot (or a connected ramp) it will not be considered "falling" and will disqualify the robot
- Robots may not catch then sort marbles
- Color determination must be done while the marbles are preparing to drop or during the fall
- The controller may be external to the robot and is not counted in the size restriction for the robot

11. Human-Robot Interface Specifications

- The HRI (Human Robot Interface) May include:
  - Teams may use any method to start the robot
  - Robot must be fully autonomous after starting
- Team members are allowed to interact with the robot only to place it on the field and start it at the beginning of the round
- Members are not allowed to modify lighting once round has started
  - Robot may adjust lighting

12. Restart

- Team may request one restart
  - The game will be paused, (items will stop falling) and the team will be given up to one minute to reset the robot
  - The game will resume at the end of one minute or when the team signals that they are ready (if earlier)
  - Any items that had been caught before the restart will be scored
  - A 10 point restart penalty will be applied to the score for that round
- Team may declare the end of the round (no penalty)

13. Important Notes

- Teams from the same organization must have clearly different solutions. Judge decision is final
- Final decisions are at the discretion of the Chief Vcc Judge

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11/07/24

14. Committee

Member	Bio
Erik Rosvold, Chairperson	Chief Operating Officer at LSM Systems Engineering. Background in electrical, mechanical and manufacturing systems. Robofest coach, host and volunteer since 2015.
Nathaniel Johnson	Nate graduated from LTU in 2007 with a MS in Electrical Engineering. His experience as a Robofest volunteer kick started his robotics career. He as travelled to Europe and Asia for autonomous driving, and now works in spatial computing, specializing in Unreal and Unity software.
Emily Trudell	Emily graduated with a MS in Computer Science from LTU in 2009. During her time at LTU she captained the Aibo Soccer team, competed in IGVC, Robogames and RoboCup. She also worked as a student assistant for Robofest and later volunteered as a judge for Vcc. She has been a professional Android developer for 11 years.
Rodrigo Rodriguez	Rodrigo is a System Integration Engineer at Ford Motor Co, Bachelor's Degree in Mechatronics and Masters degree in Artificial Intelligence from Tecnologico de Monterrey. Committed to improve STEAM education in Latin America since 2012. Robofest coach and member of Robofest Mexico Committee from 2017 to 2023
CJ Chung	Professor of Computer Science. Founder of Robofest. Director of Robofest 1999-2020. Director of LTU's CAR (CS AI Robotics) Lab. Launched Vision-based Mini Urban Challenge using L2Bots in 2007. The category name changed to Vcc in 2009. Designed Vcc challenge rules 2007-2020.

15. FAQ

- Can a camera be positioned high enough to see the marbles coming down the ramp? **Yes**, teams may position cameras anywhere on the robot. The only restriction is the height of the cups.

- How many balls will be released? The total quantity of balls is unknown but will be the same for all teams and be in the same sequence. Best estimate is two minutes at a 1-3 second release time.

- How is a marble scored that bounces out of the cup? Scoring is done at the end of the round. Teams should be prepared for "bouncing" marbles.   The inside of the cup may be modified to soften the landing although cutting the bottom of the cup out would result in marbles no longer being in the cup and would score as if they are not in the cup.

- Must the controller be on the robot? **No**, the controller is not required to be on the robot.

- Is there a video demonstration? A video demonstration of the concept will be prepared with the link posted on the Robofest page.

- Can the tower be built without the aluminum extrusions?
For testing purposes, a simple groove cut in a strip of wood would work as well as any other method that simulates the tower described. In the competition aluminum extrusions will be used.

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Little Robots, Big Missions
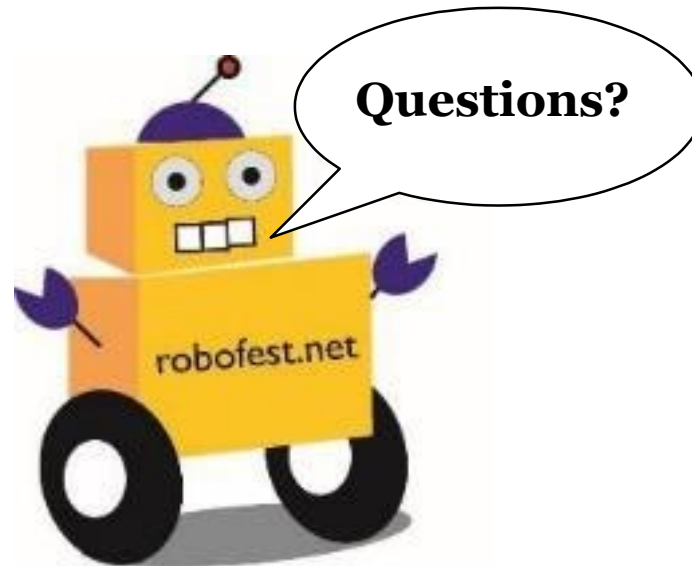
Send questions to: robofest@LTU.edu