2026 Summer School on Telerobotics and Cyborg Technologies

Multi-Robot Teleoperation Unified User Interface (UUI) Design Challenge

Comprehensive documentation for the Multi-Robot Teleoperation UUI Design Challenge, including software setup instructions, API references, robot interfaces, and development guidelines, is available at:

https://vicarios.github.io/documentation/

Participants are encouraged to consult the documentation throughout the challenge, as it contains the technical information and resources required to successfully develop and integrate their interface.

This document contains two sections: (A) UUI Design Challenge and (B) UUI Evaluation Criteria.

A. UUI Design Challenge

In this design challenge, students will work in teams of five to conceive, design, and prototype a UUI for the teleoperation of multiple robots. The objective is to create an intuitive, efficient, and user-centred interface that enables operators to seamlessly monitor, control, and configure multiple robotic systems from a single application.

The challenge emphasizes the application of established Human–Computer Interaction (HCI) and User Experience (UX) principles to support safe, effective, and engaging robot teleoperation. Teams are expected to justify their design decisions and demonstrate how their interface improves usability, situational awareness, and operator performance.

Minimum Interface Requirements

The proposed interface must satisfy the following minimum requirements:

- Optional bonus VR Integration: If feasible, the interface could provide minimal VR support, Kaptics integration and enabling one user to view the virtual world, robots in 3D and the state of the user.

- User-Centred Design: The interface should be developed following User Centred Design (UCD) principles, placing the needs, capabilities, and limitations of end users at the centre of the design process.
- Gestalt Principles: The visual layout should leverage Gestalt Principles of Design to promote clarity, consistency, and perceptual organization.
- Usability Heuristics: The interface should comply with Nielsen's 10 Usability Heuristics for User Interface Design, including aspects such as visibility of system status, consistency, error prevention, and user control.
- Dark Mode: Teams are encouraged to adopt a dark theme to improve visual comfort during prolonged operation and in low-light environments.

Functional Requirements

At a minimum, the interface must allow the operator to:

1. Select and monitor at least two robots from the available robotic platforms.
2. Visualize at least one sensor stream from each of the selected robots (e.g., LiDAR, IMU, force sensor, battery status, or other relevant telemetry).
3. Display a live camera feed from the selected robots.
4. Teleoperate the robots using navigation controls (e.g., directional controls, joystick, keyboard, or equivalent input mechanism).
5. Configure at least one robot parameter, such as the maximum navigation speed, controller gain, or another operational parameter that influences the robot's behaviour.

Teams are encouraged to extend these minimum requirements with additional features that enhance usability, situational awareness, or operational efficiency, provided that the core functionality remains intuitive and consistent with the design principles outlined above.

B. UUI Evaluation Criteria

The evaluation framework balances usability, technical relevance, creativity, and quality of execution. The table below presents the scoring criteria for each category, including score weights and evaluation dimensions.

The maximum score per team is 100 points. The UUI will be evaluated by three judges, one of whom will serve as the Judge Manager.

Table 1. Scoring weight.

Category	Weight	What to Evaluate
Task Effectiveness	25	Can a user efficiently perform multi-robot-related tasks?
Usability & UX	25	Ease of use, navigation, clarity, cognitive load
Robot-Specific Design	20	Handling of robot states, alerts, telemetry, autonomy levels
Visual Design	15	Consistency, hierarchy, readability, aesthetics
Innovation	10	Novel interaction ideas, creative solutions
Prototype Quality	5	Completeness and functionality of the Figma prototype

The Judge Manager is responsible for collecting and calculating both the judges' scores and the participants' scores. Finally, the Judge Manager will determine and report the final score for each team.

This document presents the evaluation process and assessment metrics in the following sections.

1. Task Effectiveness (25%)

Task Effectiveness (0–25 points): This evaluation rubric should answer: Can a user efficiently perform robot-related tasks? Please rate the questions of this rubric using the following task effectiveness scoring definition:

Table 2. Task effectiveness scoring definition.

Score	Description
0–10	Tasks difficult or confusing
11–20	Mostly workable
21–25	Efficient and intuitive

Each of the four questions is scored from 0 to 25 points. The final Task Effectiveness Score is calculated as the arithmetic mean of the four question scores, resulting in a final score ranging from 0 to 25 points.

2. Usability & UX (25%)

Usability & UX (0–25 points): This evaluation rubric assesses ease of use, navigation, clarity, and cognitive load. In this category, judges evaluate the interface as follows:

- Judges will use the **System Usability Scale (SUS)** survey and the **User Pain Points (UPP)** assessment metric.

First, judges should evaluate the interfaces using the SUS survey. SUS scores must be calculated according to the standard SUS methodology:

The SUS score is not the arithmetic mean of the responses.

a) For odd-numbered items (1, 3, 5, 7, and 9):
   - Contribution = Response − 1

b) For even-numbered items (2, 4, 6, 8, and 10):
   - Contribution = 5 − Response

c) Sum all 10 contributions.
   - Possible sum: 0–40

d) Multiply the total by 2.5.
   - Final SUS score: 0–100

The Judge Manager should calculate the arithmetic mean of the SUS scores for each team, resulting in a final SUS score ranging from 0 to 100. This score should then be mapped to a 0–25 scale.

Finally, the Judge Manager will subtract the UPP score from the mapped SUS score for each team. For example, if a team obtains a SUS score of 25 (after mapping) and a UPP score of 5:

SUS − UPP = 25 − 5 = 20

The resulting value will be the team's final **Usability & UX** score.

3. Robot-Specific Design (20%)

This category distinguishes strong robotics interfaces; judges will be looking for:

- Situational Awareness
- Safety
- Autonomy
- Error Handling

Robot-Specific Design (0–20 points): The Robot-Specific Design Survey contains 10 items. For each item, use a check mark if you agree with the statement and a cross mark if you disagree. The final score is calculated as the total number of check marks multiplied by two.

4. Innovation (10%)

Innovation should reward students who go beyond standard robot control panels and propose new ways for users to interact with and supervise robots. This could include creative map interactions that make navigation easier, gesture-based controls instead of traditional buttons, augmented reality (AR) features that overlay robot information onto the real world, smart alerts that prioritize important events and reduce information overload, AI-assisted supervision that helps users make decisions or understand robot behaviour, and adaptive interfaces that change based on the user's role, experience level, or current task. The purpose of this criterion is to encourage original thinking and user-centred solutions rather than simply replicating existing robot dashboards or commercial interfaces.

Innovation (0–10 points): The judge shall assign a score from 0 to 10 in the innovation assessment metric based on the degree of innovation demonstrated by the proposed interface. In assigning the score, the judge should consider whether the design introduces original ideas, novel interaction methods, or creative solutions that enhance the user experience and robot operation beyond the usability, functionality, and design aspects evaluated in the previous criteria. Higher scores should be awarded to interfaces that demonstrate significant innovation rather than simply replicating existing robot dashboards.

5. Prototype Quality (5%)

Interface Quality (0–5 points): This criterion evaluates how complete and coherent the proposed interface is from a user’s perspective. Judges should assess using the prototype quality assessment metric whether the interface supports smooth and logical navigation between different functions, provides clear and responsive interactive elements, and enables users to accomplish tasks through realistic and intuitive workflows. Higher scores should be awarded to interfaces in which all screens and features are well connected, consistent, and support efficient interaction with the robot without confusion or unnecessary steps.

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Task Effectiveness

Teams

Questions														
1) Can the operator quickly understand robot status?														
2) Can they start, stop, or control the robot efficiently?														
3) Is important information immediately visible?														
4) Are critical actions easy to find?														
Task effectiveness **FINAL SCORE**														

The Task Effectiveness score ranges from 0 to 25 points and reflects how easily users can complete tasks using the interface.
Scores between 0 and 10 indicate that tasks are difficult to perform or confusing for users.
Scores between 11 and 20 suggest that the interface is generally workable but may present some usability challenges.
Scores between 21 and 25 indicate an efficient and intuitive interface that enables users to complete tasks effectively and with minimal effort.

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User Pain Points

Teams

Questions	
1) It is difficult to navigate through the interface	
2) The information of the actions is poor and not understandable	
3) The information to perform an action is not enough	
4) Not all actions have easily access through the interface	
5) Not all the actions have navigation buttons to go where I want	
6) Prompted information is not enough to make sure that the action has been performed correctly	
7) Introducing data or navigation is confusing or hard to achieve	
8) The actions are slow to execute	
9) I do not trust the interface, I do fear to damage the system	
UPP **FINAL SCORE**	

Use a check mark if you agree with the statement and a cross mark if you disagree. The final score for each team is the total number of check marks.

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System Usability Scale

Teams

Questions														
1) I think that I would like to use this system frequently.														
2) I found the system unnecessarily complex.														
3) I thought the system was easy to use.														
4) I think that I would need the support of a technical person to be able to use this system.														
5) I found the various functions in this system were well-integrated.														
6) I thought there was too much inconsistency in this system.														
7) I would imagine that most people would learn to use this system very quickly.														
8) I found the system very cumbersome to use.														
9) I felt very confident using the system.														
10) I needed to learn a lot of things before I could get going with this system.														
SUS **FINAL SCORE**														

Select a rating from (1) Strongly Disagree to (5) Strongly Agree. Please follow the scoring procedure described in the evaluation criteria document to calculate the final SUS score.

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Robot-Specific Design

Teams

Items	
Situational Awareness, can users quickly see:	
1) Current task	
2) Battery	
3) Connectivity	
4) Sensor status	
Safety, can users:	
5) Stop the robot immediately?	
6) Understand warnings?	
Autonomy, does the interface clearly indicate:	
7) Teleoperation mode	
8) Shared control mode	
Error Handling, does it communicate:	
9) Lost connection	
10) Low battery	
Robot-Specific Design **FINAL SCORE**	

Use a check mark if you agree with the statement and a cross mark if you disagree. The final score for each team is the total number of check marks.

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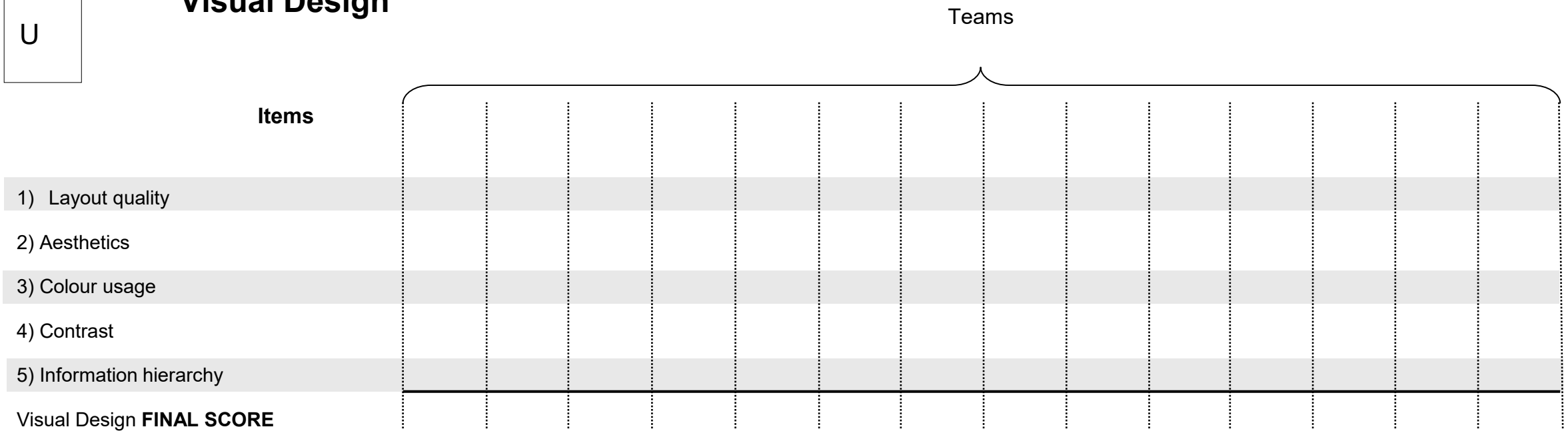
Visual Design



Select a rating from 0 to 3, where 3 is the highest score. Sum the scores for all items to calculate the final Visual Design score.

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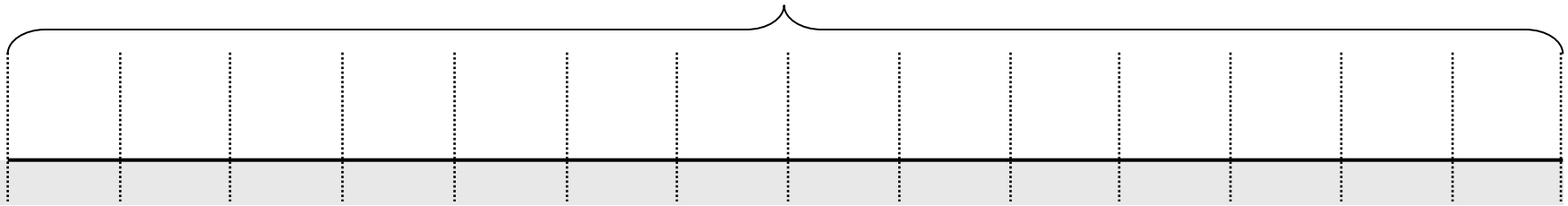
Innovation

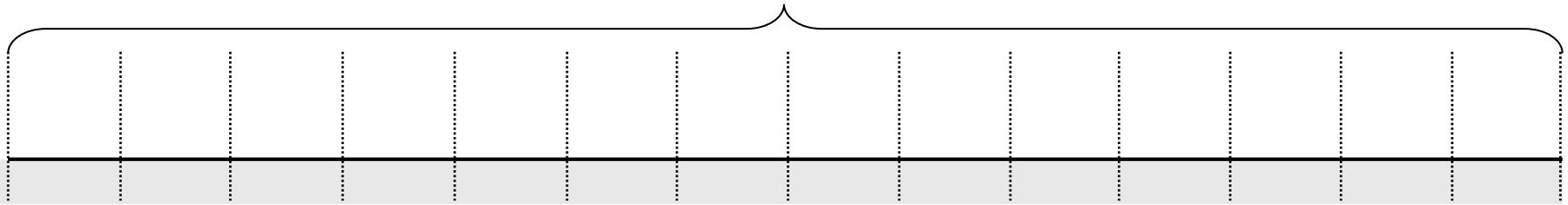
Teams



Innovation **FINAL SCORE**

Prototype Quality

Teams



Prototype Quality **FINAL SCORE**

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FINAL SCORES

Teams

1) Task Effectiveness	Judge1	
	• Judge 2	
	• Judge 3	
2) Usability & UX	Judge 1	
	• Judge 2	
	• Judge 3	
3) Robot-Specific Design	Judge 1	
	• Judge 2	
	• Judge 3	
4) Visual Design	Judge 1	
	• Judge 2	
	• Judge 3	
5) Innovation	Judge 1	
	• Judge 2	
	• Judge 3	
6) Prototype Quality	Judge 1	
	• Judge 2	
	• Judge 3	
FINAL SCORE		

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