QUEBEC ENGINEERING GAMES 2025

V1.3 - September 2024

Machine Booklet

United for the Games | 34th Engineering Games

From January 3 to 7, 2025 | École de technologie supérieure

Photo by Alain Roberge, La Presse

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Context

The year is 2525, the situation on Earth is catastrophic. In the past, Montreal's well-developed public transit network made it easy to get around the city and keep residents from different parts of the city connected. The metros, buses and trains that tied the metropolis together socially and economically are now just memories of a bygone era.

Devastating storms have left neighborhoods in ruins, filled with obstacles and Montreal's famous cones in every corner of the city. The extreme weather conditions have resulted in uneven terrain that makes conventional vehicles ineffective. Isolated residents are desperate for a way to safely move around the city.

To respond to this crisis, the Engineering Games Transit Society is proposing a challenge: to develop a solution that will meet the needs of the year 2525.

Next January 6th, participating teams will propose a solution to efficiently transport city residents to their desired destinations and thus rebuild the ties that unite Montreal.

The summer of 2024 was marked by numerous floods and infrastructure damage in Montreal, partly due to the passing of Tropical Storm *Debby*. (Photo: Mario Beauregard/Agence QMI)

1 Description of the challenge

The challenge is conducted in two stages to test the versatility of the proposed robotic solution on different types of terrain. The stages are as follows: a trial on water followed by a trial on land.

1.1 Stage1 – Water trial

This trial is a pre-qualification test in front of the public to get access to the flooded area during the land trial (Stage 2). This step aims to prove that the solution can navigate in hostile environments during the land trial.

This step will be considered accomplished if the robotic solution manages to leave the dock by touching it, go around the obstacles in the pond and touch the dock again.

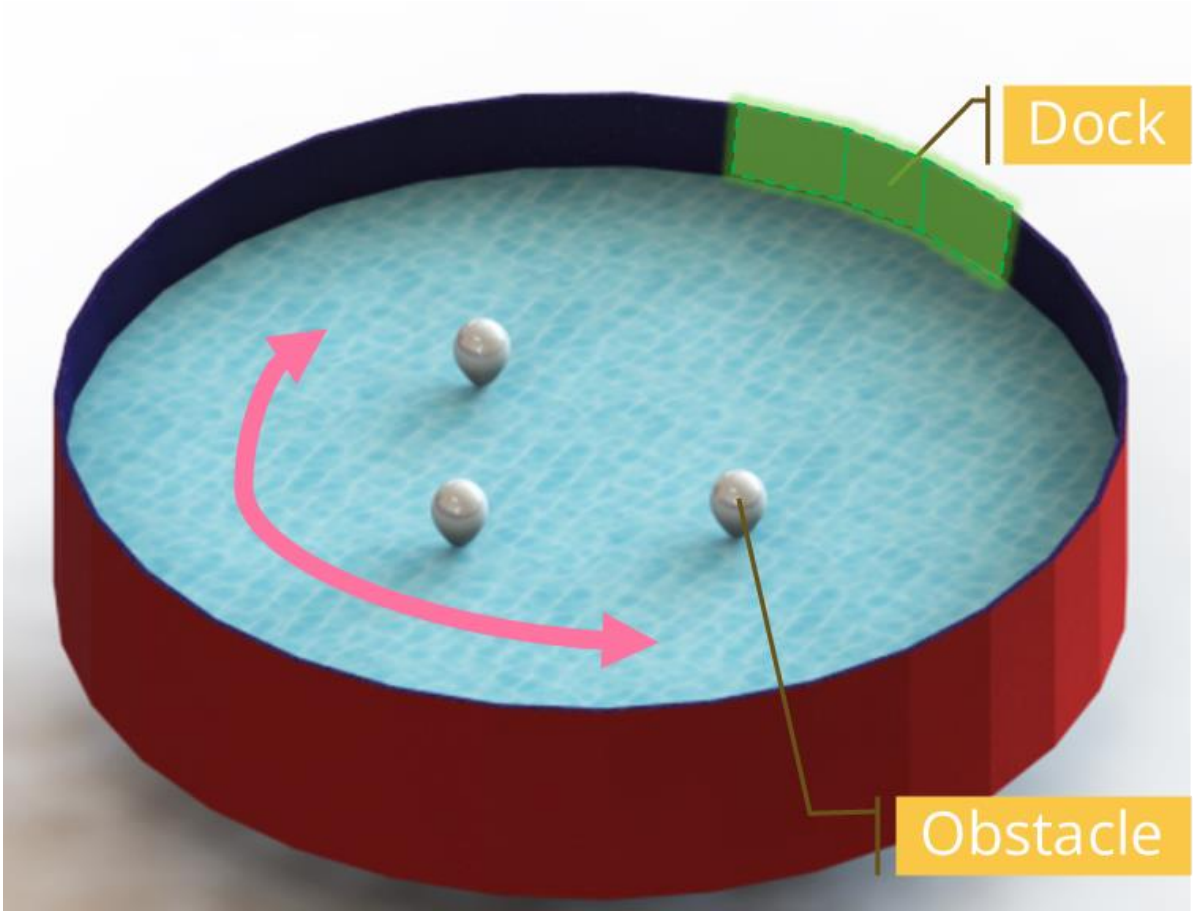

Figure 1.1 - Visualization of the water terrain

1.2 Stage 2 – Land trial

The goal of this trial is to demonstrate the robotic solution's ability to efficiently transport passengers while clearing the city of construction cones. The robotic solution has 7 min to achieve the goals of this stage. This trial will automatically start 2 min after the start of the water trial.

Each team must develop a robotic solution that can transport passengers between the 5 different stations throughout the city. Passengers are gradually added to the stations, and they wait for your solution to transport them to their chosen destination. If a station reaches its maximum capacity, the remaining time for the trial accelerates and passes twice as quickly. The challenge for the teams is to demonstrate how their robotic solution can efficiently manage this process.

In addition to transporting passengers, robotic solutions are tasked with clearing the city of construction cones. Your solution must gather the cones scattered on the ground and deposit them in the storage area.

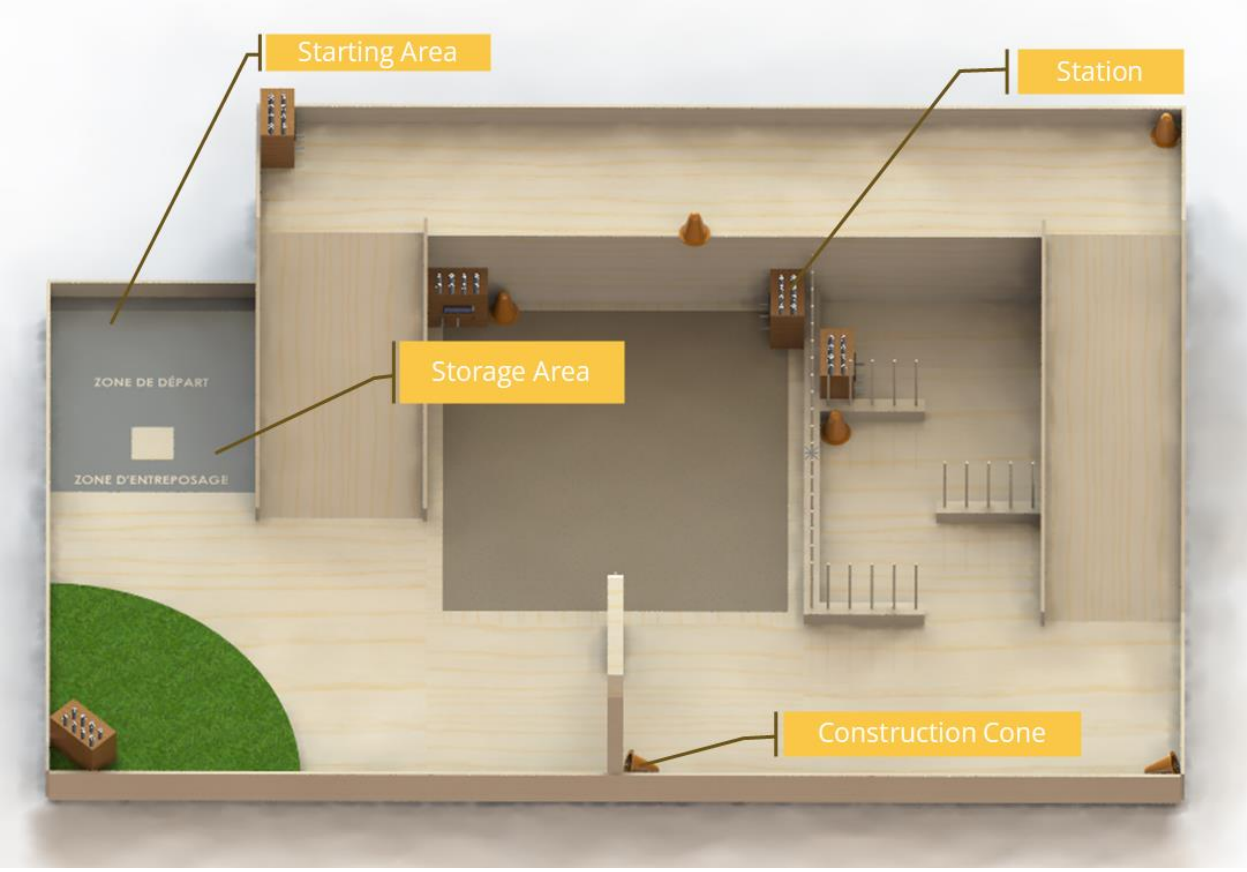

Figure 1.2 - Visualization of the land terrain

2 Terrain Presentation

This section describes the different parts of the terrain. A complementary document is provided to reproduce the conditions of the official terrain (Construction Booklet). The terrain modeling is also made available to you in a STEP file (Course Drawings).

2.1 Water trial

This section of land is a 55.1" diameter collapsible pool, containing 7" of water in depth. There are 3 obstacles to navigate around.

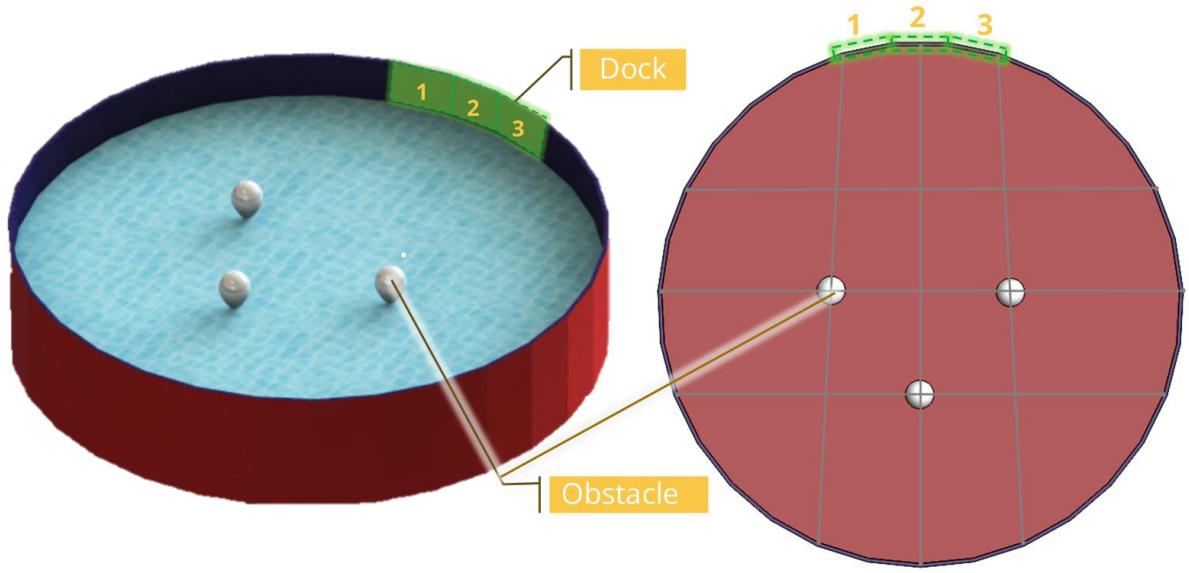

Figure 2.1 Water pond showing dock and obstacles

Dock The dock is an area delimited by 3 consecutive panels on the pool wall. This area corresponds to both the start and finish areas for this trial.

Obstacle The obstacles to avoid are balloons anchored in the pool.

2.2 Land trial

This competition field is a 74” X 104” area, designed to simulate the environment of Montreal in 2525. It is divided into multiple sections.

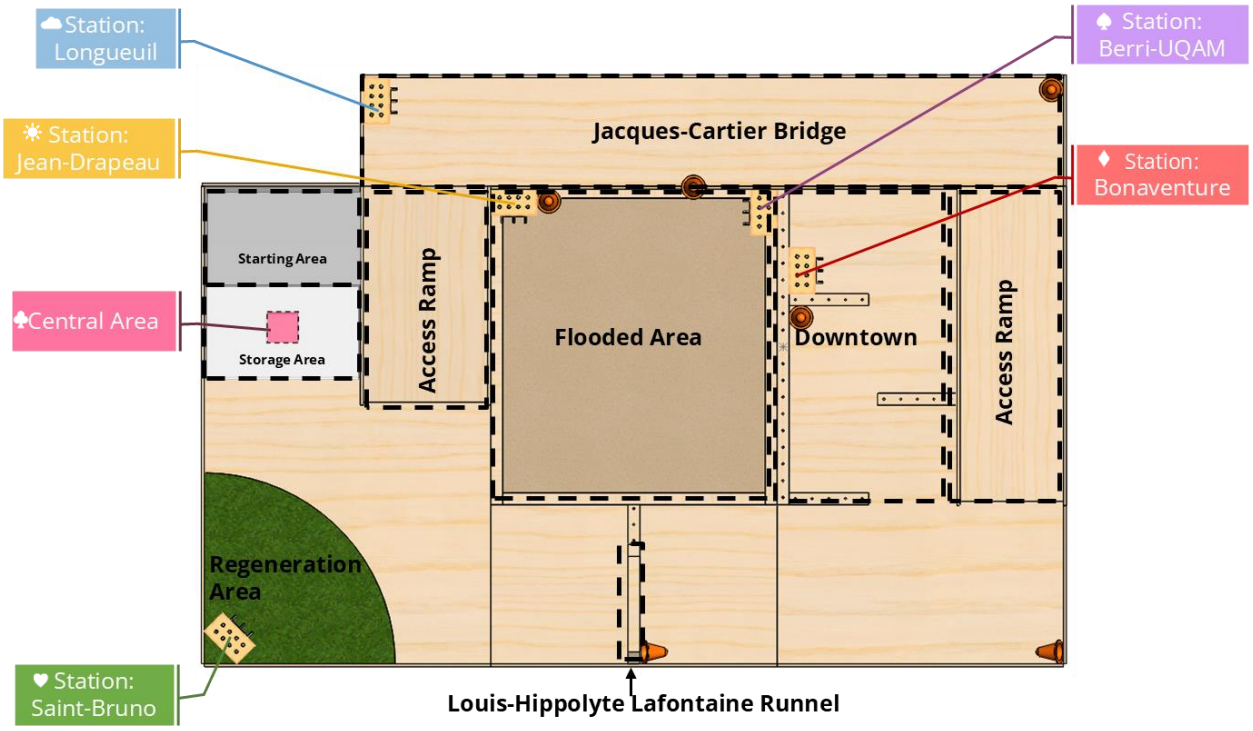

Figure 2.2 - Land trial terrain sections

Starting Area The starting area is a rectangle of 12” X 19.625”.

Storage Area The storage area is a 12” X 19.625” rectangle adjacent to the departure area. The central area (♠ pink) is located inside the storage area and is a 4” X 4” square.

Regeneration Area This area represents the Saint-Bruno park in regeneration after a fire that occurred a few years ago. The current vegetation measures 1” in height and covers a quarter circle with a radius of 24”. The Saint-Bruno station (♥ green) is located in this area.

Flooded Area This area corresponds to the St. Lawrence River. The area measures 36” X 40” and is filled with sand. The Jean-Drapeau station (☀ yellow) and the Berri-UQAM station (♠ purple) are within that area.

Downtown

In 2525, downtown Montreal remains a true maze. Bonaventure station (♦ red) is hidden at the bottom of this zone.

Jacques-Cartier Bridge

This bridge is located at a height of 10”. It allows you to cross the flooded area without entering it. The Longueuil station (☁ blue) is located there. To access it, you must take one of the access ramps.

Access ramps

Two access ramps allow access to the bridge. One has a 20° incline and the other has a 14° incline.

Louis-Hippolyte Lafontaine Tunnel

It allows crossing the flooded area without entering it. The maximum height of a solution, to pass under the tunnel, without risk of collision is 13.5”.

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3 Challenge Elements

3.1 Stations

The stations are control points where the robots must load and unload passengers. There are 5 stations located throughout the city: Saint-Bruno (♥ green), Jean-Drapeau (☀ yellow), Berri-UQAM (♠ purple), Bonaventure (♦ red), and Longueuil (☁ blue). The Jean-Drapeau (☀ yellow) and Berri-UQAM (♠ purple) stations are only accessible if the team has successfully completed the water trial.

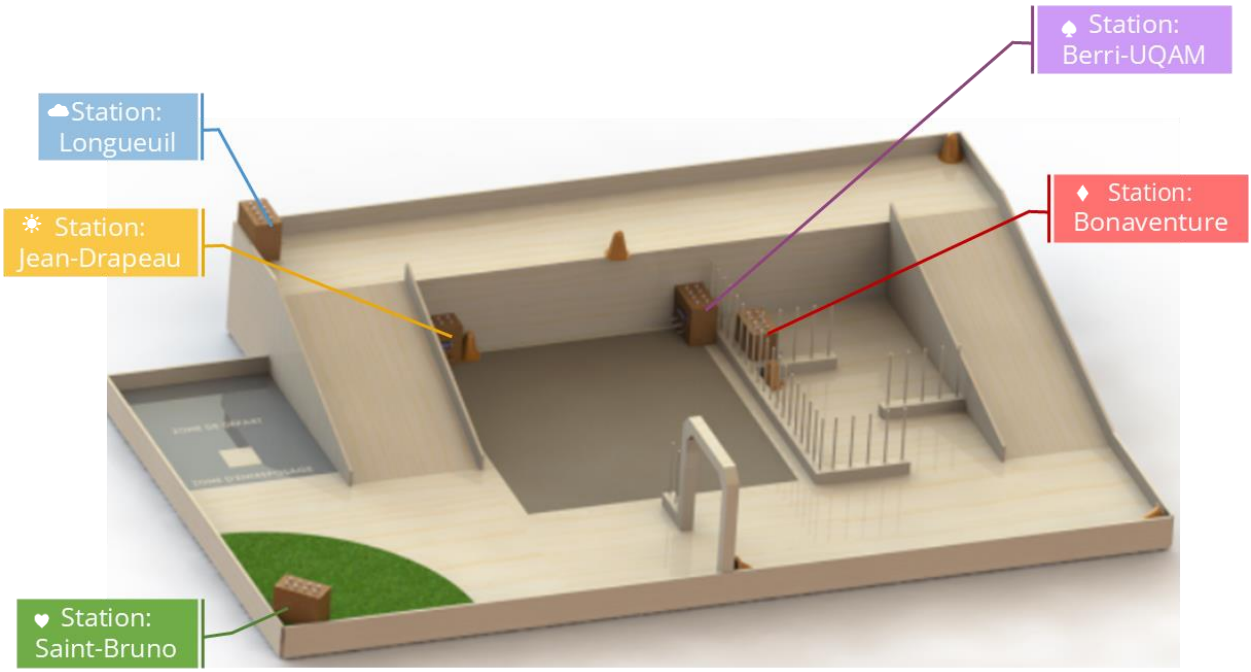

Figure 3.1 - Locations of the Stations

At the start of the land trial, each station begins with 2 passengers waiting. Every 30 seconds, 1 new passenger with a random destination joins each station. Each station can accommodate a maximum of 8 waiting passengers. When a station is full, the remaining time of the trial elapses at twice the normal speed. This time acceleration effect applies as long as a station is full, regardless of the number of full stations. Time proceeds normally as long as all five stations can accommodate new waiting passengers.

To pick up or drop off a passenger, the robotic solution must communicate with the station via its three terminals located on the station and the black box.

When the solution drops off a passenger at the correct station, an increment in the number of passengers dropped off is displayed on the station's LCD screen. Following the passenger drop-off, all the station's lights will flash several times equal to the number of correctly dropped-off passengers.

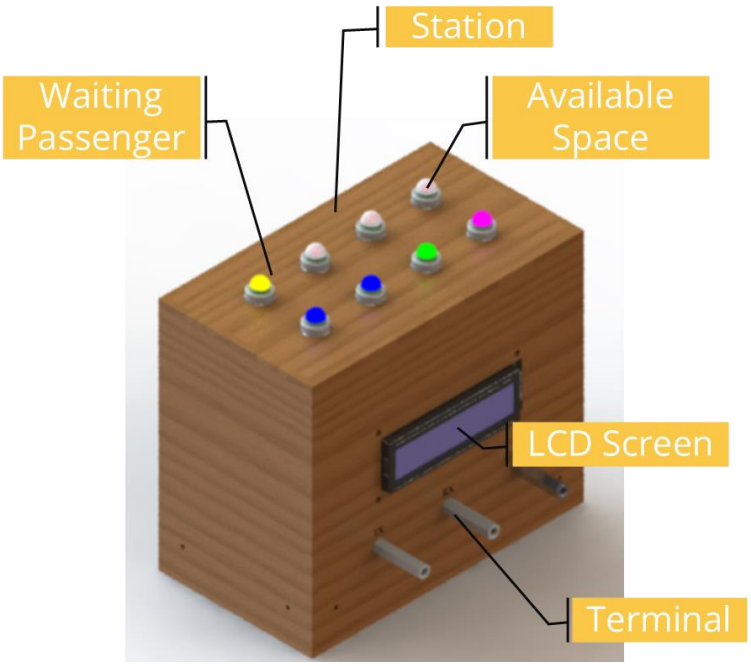

Figure 3.2 - Example of a Station

Bonus Points

Among the commands that the solution can send to the station, a secret command can be sent to earn bonus points. These points can only be earned once per trial. The secret command must be sent to the black box when it is connected to a station. If the correct command is sent, a visual animation will be triggered on the station.

3.2 Passengers

A passenger is represented by a lit LED. Each LED color corresponds to a specific destination where the passengers wish to be dropped off. For example, in Figure 3.2 (above), in the station section, you can see the red station with 5 passengers waiting to be transported: 2 to the blue station, 1 to the purple station, 1 to the green station, and 1 to the yellow station.

The LEDs used are of the WS2811 type with an operating voltage of 5V. If you need the specifications for the LEDs, you can follow the link.

3.3 Cones

There are 6 cones placed throughout the city. The positions of the cones on the field are shown in the construction manual. The robotic solution must bring the cones it encounters along its path to the storage area.

If you need the specifications for the cones, you can follow the link.

Bonus Points

Bonus points will be awarded for each cone stacked in the central area.

3.4 Storage Area

The storage area is the space where cones must be deposited. It is located in front of the starting area and has the same dimensions. Cones can be placed anywhere within this area, provided that the entire cone is within the zone. However, any cones placed within the central area will receive bonus points. The central area is represented by a 4x4 square located within the storage area. For a cone to be considered within the central area, the entire cone must be contained within this zone.

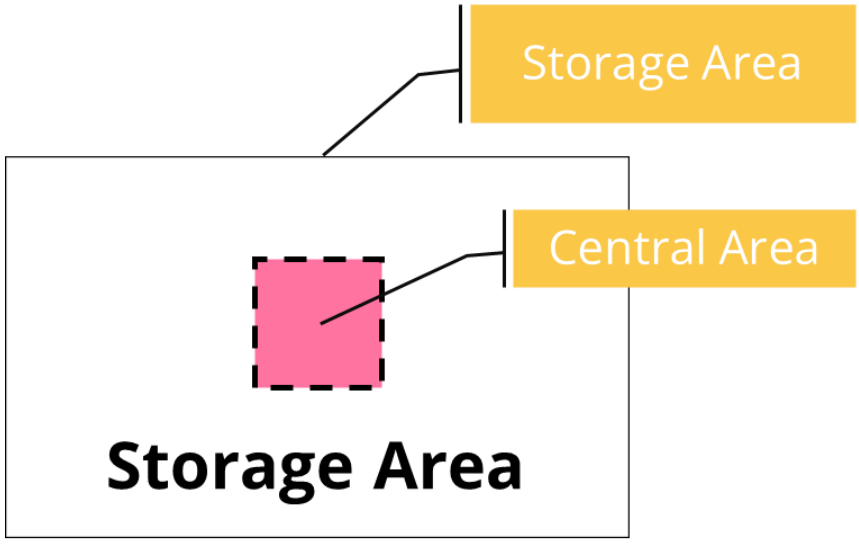

Figure 3.3 – Storage Area

3.5 Black Box

The black box is a component provided by the organizing committee (OC). It is a module that must be integrated into the robotic solution to communicate with the stations.

The black box serves several functions:

- Communication: It acts as an intermediary for communication between your robot and the stations. It enables the exchange of information between the station and the robotic solution.
- Transport Capacity: The robotic solution can transport a maximum of 5 passengers at a time. Each passenger on your solution must be clearly visible and represented by an LED during the trial. It is the responsibility of each team to integrate the lights representing the passengers on their robot. These lights can only be controlled by the black box.

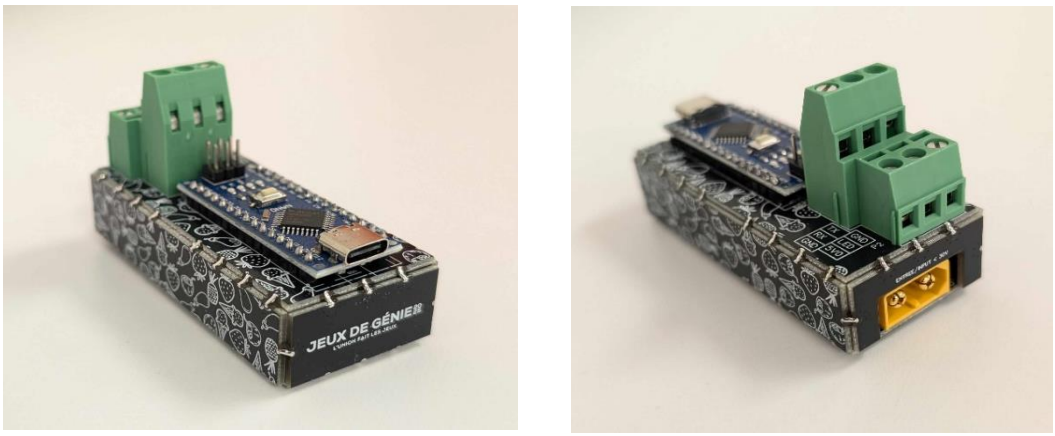

Figure 3.3 – Black Box

3.6 Communication

Communication refers to the exchange of information between the black box mounted on your robotic solution and the stations. Your solution must connect the black box to the station via a 3-terminal connection system to exchange passengers. The robot can then instruct the black box to load or unload a certain number of passengers.

To do this, once the black box has established a valid connection with a station, the solution can send a command to the black box via a serial connection over USB. This command will then be transmitted to the station.

4 Rules

4.1 General

4.1.1 Rights of the CO

The organizing committee reserves the right to modify these documents at any time, and will notify you of changes, if there are any. In case of a discrepancy between the French and English versions of this document, the French version prevails.

4.1.2 Respecting the instructions

All teams must follow the instructions given by the organizing committee. Any violation of the rules will bring about penalties, up to and including disqualification.

4.1.3 Late submissions

Teams must respect the submission deadlines for deliverables. Lateness will not be tolerated without a valid reason approved by the CO. Penalty is 20% per day late.

4.1.4 Safety rules

The robotic solution must not present any danger to the people present during its use. The use of explosives, fire or any other dangerous material is strictly forbidden.

4.1.5 Water safety

During the trials, no electrical component may come in direct contact with the water.

4.1.6 Flying solutions

Flying solutions are not allowed.

4.1.7 Animals

No animals are allowed to be a part of the robotic solution.

4.2 Design and Construction of the Solution

4.2.1 Integration of the black box

The black box, the PCB provided by the CO, is required to be integrated into the passenger transport solution, as specified in Appendix A.

4.2.2 Modifying the black box

The black box may not be modified nor damaged.

4.2.3 Position of the black box on the solution

The black box must be easily replaceable. The CO must be able to replace the black box at any time.

4.2.4 Communication with the black box

Communication between the robot and the black box must be done via the black box's USB port or the authorized UART connection.

4.2.5 Communication between the solution and the station

The solutions must connect to the station via a 3 terminal connection system to exchange passengers. The exchange must be done through the black box provided by the CO. No other method of communication with the stations is allowed.

4.2.6 Communication between the driver and the solution

The only element of communication authorized to communicate with the solution is the control system. The system does not have any mass nor size restrictions but must be wireless, battery powered, and respect the same safety rules as the robotic solution.

4.2.7 Transport capacity

The robotic solution may transport a maximum of 5 passengers at a time on board of the transport solution. The teams are limited to the use of a single black box.

4.2.8 Displaying of passengers on the solution

Each passenger on board the solution must be represented by a visible LED connected to the black box.

Penalty

If the solution is not able display its passengers on board, a 2 points penalty will be applied to each passenger that arrives at their destination.

4.2.9 Addition of a fuse

If one or more batteries are used to power the robotic solution, a fuse must be installed to protect the system against surges. The fuse must be positioned as close as possible to the battery and properly sized. The presence of this protection will be verified and will be necessary to participate in trials.

4.3 Public Demonstration

4.3.1 Duration

During the public demonstration, each team must start by completing the water trial before being able to continue with the land trial. The time for the land trial is a maximum of 7 minutes and will automatically start 2 minutes after the start of the water trial. However, the teams may start their land trial at any time. The public demonstration finishes at the end of the land trial.

4.3.2 Robotic Solution Driver

During the public demonstration, the team may only designate a single driver responsible for controlling the robotic solution.

4.3.3 Driver's Positioning

To allow the judges and spectators to see the trials well, certain areas are allotted for the driver and their assistant. These two must be crouching when in the restricted area.

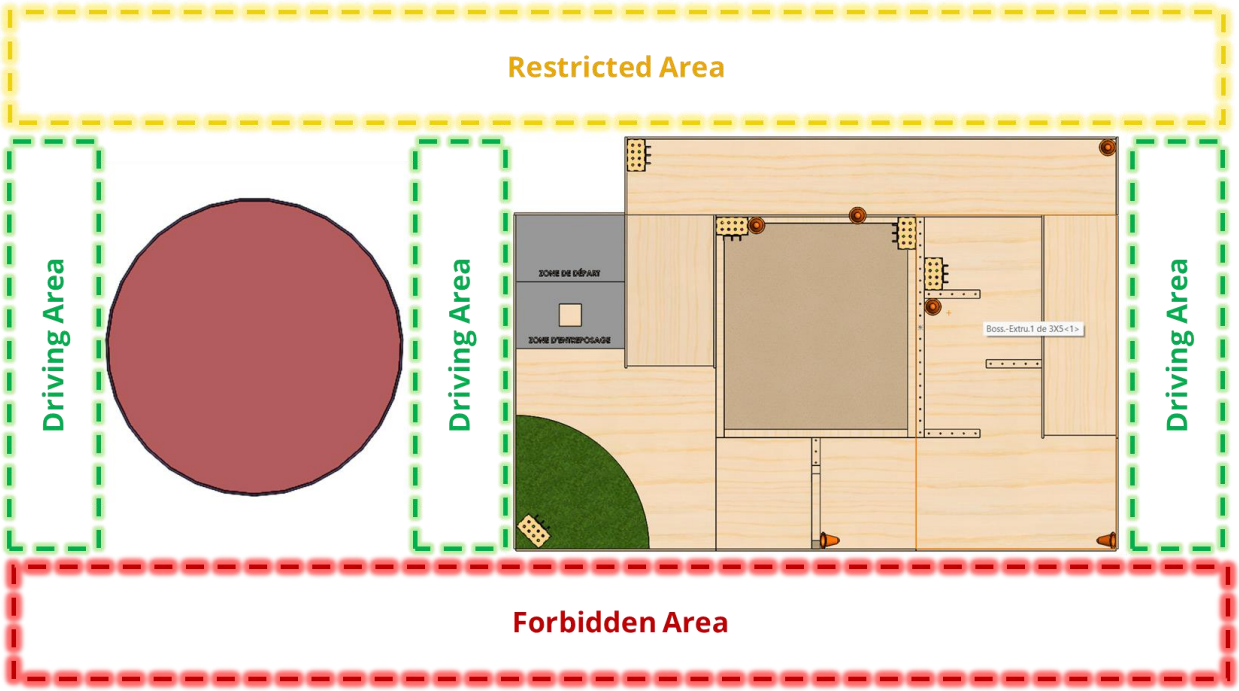

Figure 4.1 - Team positioning during the public demonstration

4.3.4 Volume Inspection

Before starting the land trial, the solution must fit in an inspection volume of 12" x 12" x 12" without external aid. The volume must be confirmed by a member of the CO before being able to start the trial. The inspection volume will be represented by a rigid box.

4.3.5 Course Integrity

It is forbidden to damage or soil the course. To that extent, a robotic solution must not in any case leave any material, residue or any other element that may compromise the quality and integrity of the courses.

Penalty

Each breakage or damage of an element of the course may result in a penalty of 20% of the final score or disqualification, at the discretion of the CO.

4.3.6 Integrity of the Robotic Solution

In the event of a part breaking during the trial, if the part left behind is deemed damaging to the trial by an organizer, the solution must be reset. During the reset, the part must either be repaired or discarded.

4.3.7 Repairing during the trial

If a team must repair their solution during the trial, they must do a reset and may take as long as needed to perform their repairs. The repair must be done outside of the track or in the starting area. However, only manual repairs not requiring power tools are accepted. Additionally, no new code may be sent to the solution. Time does not stop during a reset.

No repairs are allowed between the water and land trials.

4.3.8 Resetting of the solution

The resetting of the robotic solution must be done by following these steps:

1. Take possession of the robotic solution.
2. If necessary, they must give back any cones in the solution's control to an organizer. Cones in the solution's control will be lost.
3. If necessary, set the black box back to zero. Passengers on board the solution will be lost.
4. Take the solution and place it according to the appropriate starting rules.
5. Wait for the approval of an organizer.
6. The trial may continue.

Time for the trial does not stop during a reset. No resets are allowed between the water and land trials.

Penalty

Each reset of the solution also carries a penalty of 20% on the final score.

4.3.9 Definition of control of a cone

An element is considered in control of the robotic solution if any part of the mass of the element is supported by the robotic solution.

4.3.10 Contact with the course or the solution

No one may come in contact with the course or the solution throughout the duration of the trial. An infraction of this rule will result in a reset of the solution without a stoppage in time.

4.3.11 Robotic solution leaving the course

A robotic solution that touches anywhere outside the terrain must be reset. The solution may extend past the perimeter of the course if it does not come in contact with the ground.

4.3.12 Modification of the solution during the demonstration

During the public demonstration, it is strictly forbidden to make any physical or software modifications to your robotic solution.

4.3.13 Start of the water trial

Before starting the water trial, the team must ensure that the robot is in contact with the dock. The team must then signal the organizers that they are ready. Once the organizers are ready, one of the organizers will start a 3 second countdown. Once the countdown ends, the team may begin their trial.

4.3.14 Movement within the pond

The solution must not be dependent on the walls to navigate the pond or to move. However, collisions with the walls will be tolerated.

A water trial is considered accomplished if the robot is able to start from the dock and touch the dock after having gone around all of the obstacles in the pond. The entirety of the robotic solution must go around the obstacles.

4.3.15 Start of the land trial

Once the solution is positioned in the starting area and its volume has been validated, the team must signal to the organizers that they are ready. Once the organizers are ready, one of the organizers will start a 5 second countdown. Once the countdown ends, the team may start their trial.

4.3.16 Starting area

The robotic solution must be able to be entirely contained in the starting area without external help before the start of the land trial.

4.3.17 Access to the flooded area

Only robots who have completed the water trial are able to access the flooded area. For robots that have not completed the water trial, the flooded area is considered to be outside the course. Note that the stations will always be active.

4.3.18 Cone exiting the course

In the event that a cone leaves the course, only the robot may interact with the cone.

4.3.19 Definition of a valid cone

A cone is considered to be inside the zone if the entirety of the cone is inside the zone.

4.3.20 Points for cones

The points for the cones are counted at the end of the trial.

4.3.21 Dropping off passengers

All passengers dropped off at a station must have been picked up from another station.

5 Logistics

5.1 During the Engineering Games

A handbook specific to the machine periods as well as other details related to the week of the Engineering Games will be published later in the year. For now, you can assume that the procedures will be similar to those of previous years (see Appendix C).

A maximum of 4 people will be allowed on stage:

- A Driver who may move between the driving zones and the restricted zone.
- An Assistant responsible for helping the driver, who may move between the driving zones and restricted zone.
- A Mechanic who must stay off stage during the test but may help with setting up and resetting the robotic solution.
- A Co-Animator who must stay with the host animator, responsible for helping entertain the crowd (note that they are not required to be a machinist, but they must know their university's machine).

Please refer to the logistics handbook for more details regarding the logistical aspects of the 2025 Machine challenge. Unless otherwise specified by the Organizing Committee, the handbook should be released on December 1st, 2024.

6 Points

The points for the public demonstration are awarded according to the following criteria:

Table 6.1 - Evaluation Criteria and Their Scoring

Description	Points
Success on the water trial	+40
Transport of a passenger to the correct station	+10/passenger
Missing indicator for a passenger on the robot	-2/passenger
Cones in the storage area	+5/cone
Cones in the central area	+10/cone
Secret command	+10

Table 6.2 - Description of Penalties

Description	Penalty
Reset	-20%/reset
Course damage	-20%/damage

$$Final\ score = \left(\sum Points\right) * \left(100 - \sum \%penalties\right)$$

$$Weighted\ final\ score = \frac{Team\ score}{Highest\ team\ score} * 60$$

Figure 6.1 - Calculation of the Final Score and the Enhanced Score

7 Deliverables

7.1 Important Dates

The following timeline presents all of the important dates over the course of the machine competition for the 2025 Engineering Games.

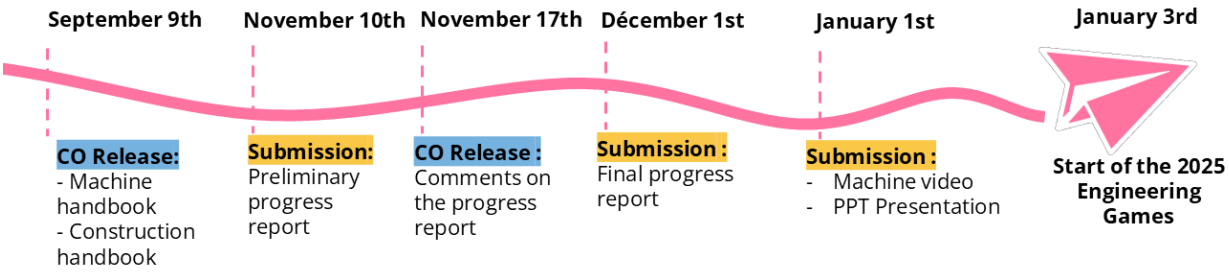

Figure 7.1 - Important Dates

7.2 Evaluation Rubric

The evaluation rubric below presents the weighting of the deliverables for the machine competition.

Table 7.1 - Weightings of Deliverables and Their Nomenclature

Deliverables	Weight	Submission Naming Convention *'UNI' should be replaced with your university's acronym (see Appendix B).*
Progress Report	13 %	Rapport_Prelim_UNI Rapport_Final_UNI
Presentation for the Judges	20 %	Presentation_Machine_UNI
Presentation Video	7 %	Video_Machine_UNI
Public Demonstration	60 %	N/A
Total	100 %	N/A

All deliverables to be submitted must be named according to the naming convention presented in the table above. Refer to the table in Appendix B to find the acronym each university should use to replace 'UNI' in the nomenclature.

7.3 Progress Report

The progress report aims to inform the organizing committee on the progress made on your robotic solution. It must be concise and clearly present your engineering process while concentrating on the most recent version of your robotic solution.

The report should be maximum 12 pages, including the title page and table of contents. The annexes are not included in this page limit. However, these annexes must not contain information necessary to comprehend the report.

Table 7.2 - Progress Report Evaluation Criterias

Evaluation Criterion	Points
Report structure and clarity	2
Overview solution presentation	2
Subsystem presentation	3
Envisioned strategy and expected results	3
Risk management process	3
BONUS: CAD of your solution	1
Total	13

7.3.1 Report Structure and Clarity

The clarity of the report will be evaluated according to two criteria:

1. The quality of the language: the effectiveness of communication, the plan's structure and flow will be examined.
2. The presentation's quality of the report: the aspects that facilitate the comprehension of the report (title page, table of contents, clear and relevant figures, etc.) will be examined.

7.3.2 Overview Solution Presentation

The solution should be presented at a high level. To ensure a good comprehension, the following elements should be discussed:

- Presentation of the movement system;
- Presentation of the station communication system;
- Presentation of the cone management system;
- Presentation of the control system.

7.3.3 Subsystem Presentation

The subsystems should be presented in detail. The following points will be considered:

- Criteria that influenced your choice;
- Advantages of your choice;
- Points to reconfirm concerning their performance.

7.3.4 Envisioned Strategy and Expected Results

You must present your strategy to optimize the efficiency of your robotic solution while keeping in mind the strengths and weaknesses of your solution. You will not be judged for the ambition of your expectations, but rather on your ability to maximum your time and evaluate your performance realistically. The following points will be considered:

- Strategy for the water trial and expected results;
- Strategy for the land trial and expected results.

7.3.5 Risk Management Process

Whether they are risks related to your design or to your strategy, they must be considered in a mitigation and contingency plan. You must therefore present your risk management process while discussing the following points:

- Risk identification;
- Identification of the likelihood and impact of these risks;
- Mitigation plan: how to reduce the probability of these risks occurring;
- Contingency plan: how to reduce the impact should these risks materialize.

7.3.6 BONUS: CAD of your solution

A bonus of up to 1 point will be awarded to teams who provide a CAD of their robotic solution. This may be partial or complete. It should not be essential to the comprehension of the report and can not increase your total score for the progress report above 100% of the total points.

The reports must be submitted by email to machine@jeuxdegenie.qc.ca as a .PDF.

7.4 Presentation Video

The presentation video must introduce your team and robotic solution to the public. It must be 3-4 minutes long. The goal is to entertain and inform the public about your university, your team, and your creative process.

The video may be in French or in English. The video must be submitted by email to machine@jeuxdegenie.qc.ca as a .MP4 file.

Table 7.3 - Evaluation Criteria for the Presentation Video

Evaluation Criterias	Points
Introduciton of the team and university	1
Presentation of the solution	2
Presentation of the strategy	1
Popularization of the content	1
Originality	1
Video duration and quality	1
BONUS: Subtitles in the opposite language	1
Total	7

Penalty

If it is deemed inappropriate by the CO, il will not be shown and will receive a score of 0/7. In case of doubt, refer to the VPs of Machines of the organizing committee.

7.4.1 BONUS: Subtitles in the opposite language

A bonus of up to 1 point will be awarded to teams who add subtitles in the opposite language to their video. It may not increase your total points for the video above 100% of the points.

7.5 Presentation for the Judges

You will need to present your solution before a panel of judges. The goal of this presentation is to show the results of your design process and your expectations concerning your solution. The panel of judges will consist mostly of engineers, some who are not familiar with robotic design. The presentation has a length of 10 minutes, followed by 5 minutes of questions.

Table 7.4 - Evaluation Criteria for the Presentation to the Judges

Evaluation Criteria	Points
Team and university introduction	1
Presentation of the solution	6
Review of the design	3
Presentation of the strategy and expected results	5
Presentation structure and professionalism	2
Question period	3
Total	20

The presentation must be submitted by email to machine@jeuxdegenie.qc.ca either as a .PPTX or .PDF file.

7.6 Public Demonstration

During your public demonstration, you must start by completing the water trial followed by the land trial. The time for the land trial is a maximum of 7 minutes and will automatically begin 2 minutes after the start of the water trial. Nonetheless, teams may begin their land trial at any time.

The points for the public demonstration will be calculated according to the Points section.

8 Questions and Organizing Committee

For any questions regarding the machine booklets, please submit them in the Question Machine 2025 form. Questions and their answers will be posted in a file that is also accessible on in the FAQ document (also available on the 2025 Engineering Games website).

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Appendix A
Black Box

A.1 Description

The black box is a component that allows the robotic solution to transfer passengers from and to the Station. It is responsible for communications with the Station and keeping count of the passengers held by the robotic solution. The black box controls 5 RGB LEDs to represent the passengers it has in hand. It also controls an LED that indicates an unstable or absent connection with the station.

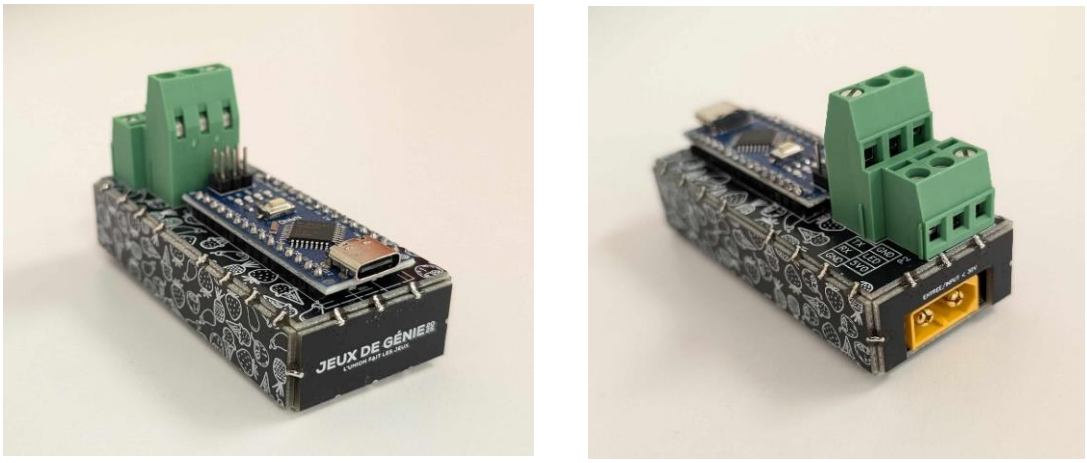

Figure A.1 - Black box

A.2 Specifications

Below are the specifications related to the black box.

Table A.1 - Black Box's Specifications

Symbol	Parameter	Min	Typ	Max	Unit
Vbat	Input voltage of the battery	5.5		30	V
Vout	Output voltage of the buck converter		5.0		V
Iout	Output current of the buck converter		0.5	1.0	A
Fsw	Switching frequency of the buck converter		572		kHz
%eff	Efficiency of the buck converter	80		90	%
Iq, U1	Quiescent current of U1		116		µA

A.3 Connexions

The communication between the Robotic Solution's controller and the black box is done through UART over USB using a Mini-USB cable. The black box is based off an Arduino Nano; therefore, the communication works the same to that of a computer with an Arduino.

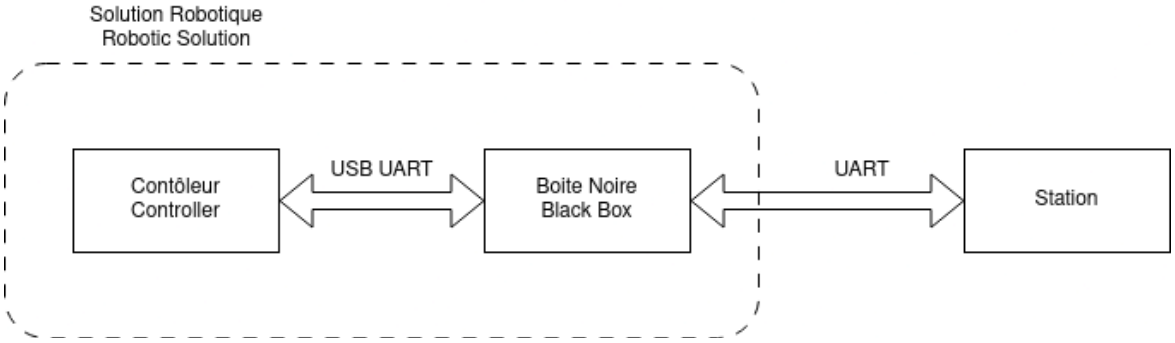

Figure A.2 – "Communication between the controller and the black box

Communication between the black box and the Station is done through UART with three (3) wires that the Robotic Solution must place for the communications to work. The wires must be hooked up as follows:

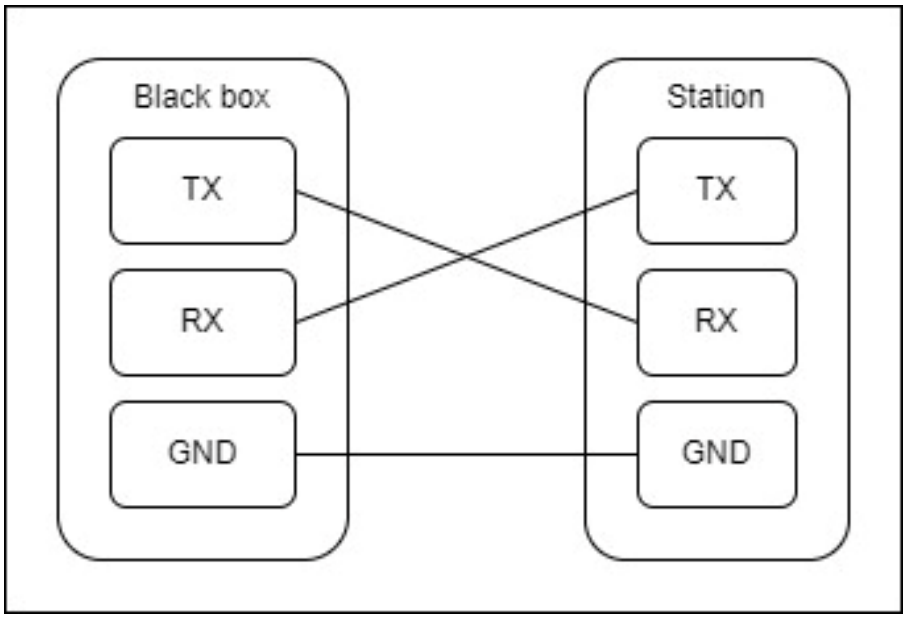

Figure A.3 – Communication between the black box and a station

A.4 Communications

The communication protocol is done over a UART connection at a baud rate of 115200. The protocol consists of a command and response system, that is, the Robotic Solution sends a command to the black box, then receives a response from the Black Box.

The general format of these messages are as follows:
MESSAGE:ARGUMENT1:ARGUMENT2\n

Note that each message ends with e newline character '\n'.

The list of possible commands sent by the robotic solution is as follows:

Table A.2 - List of possible commands between the robotic solution and the black box

MESSAGE	ARGUMENT 1	AGUMENT 2
TAKE	*Color*	*Number*
SEND	*Color*	*Number*
INFO	S	
INFO	B	
INFO	C	

A.4.1 Colors

The valid colors for the above commands are the following:

- RED
- GREEN
- BLUE
- YELLOW
- PURPLE

A.4.2 Numbers

The numbers used in the above commands can be between 1 and 99, written as text.

A.4.3 Common Responses

Each command has its own possible responses, however, there are responses that are in common with all commands.

Table A.3 - Common responses for commands

Message	Description
ERR:command_too_long\n	The message sent is too long
ERR:command_in_progress\n	The last command sent is still being executed
ERR:unknown_command\n	The command sent is unrecognized
ERR:disconnected\n	The Black Box is not connected to a station

A.4.4 TAKE Command

The TAKE command is used to transfer a certain number of passengers of a certain color from the Station to the black box. The command has the following format: TAKE:Color:Number\n

Here is an example: TAKE:R ED:2\n

Table A.4 - Possible responses to the TAKE command

Message	Description
OK\n	The transfer of passengers is complete
ERR:invalid_color\n	The given color is invalid
ERR:invalid_count\n	The given number of passengers is invalid
ERR:not_enough_room\n	There is not enough room in the Black Box to accomodate the requested passengers
ERR:not_enough_people_at_station\n	There are not enough passengers at the station for the requested transfer

A.4.5 SEND Command

La commande SEND sert à transférer un certain nombre de passagers d'une certaine couleur de la boite noire a une station. La commande a le format suivant: SEND:Couleur:Nombre\n

Voici un exemple: SEND:YELLOW:5\n

Tableau A.5 – Réponses possibles à la commande SEND

Message	Description
OK\n	Le transfert de passagers est complet
ERR:invalid_color\n	La couleur n'est pas valide
ERR:invalid_count\n	Le nombre de passagers n'est pas valide
ERR:not_enough_people_to_send\n	Il n'y a pas assez de passagers dans la boite noire.
ERR:not_enough_room_at_station\n	Il n'y a pas assez de place à la station pour accueillir les passagers.

A.4.6 INFO Command

The INFO command is used to gather certain information about the black box and the Station.

Passengers at a Station

A command is available to use to get the count of passengers of each color at a Station. The command has the following format: INFO:S\n

The response has the following format: OK:Number of Red:Number of Green:Number of Blue:Number of Yellow:Number of Purple\n

For example: OK:0:1:4:1:2\n
Which is, 0 red passengers, 1 green passenger, 4 blue passengers, 1 yellow passenger, and 2 purple passengers are at the station.

Passengers in the black box

A command is available to use to get the count of passengers of each color in the Black Box. The command has the following format: INFO:B\n

The response has the following format: OK:Number of Red:Number of Green:Number of Blue:Number of Yellow:Number of Purple\n

For exemple: OK:0:1:1:1:2\n
Which is,, 0 red passengers, 1 green passenger, 1 blue passenger, 1 yellow passenger, and 2 purple passengers are in the black box.

Color of the station

A command is available to use to get the color of the station for which the Robotic Solution is connected to. The command has the following format: INFO:C\n

The response has the following format: OK:Color\n

A.4.7 Secret Command

The black box can accept a secret command. When this secret command is issued, the station will display a special animation on the passenger LEDs. Once this animation is played,

you will receive bonus points for it. The secret command is located somewhere within the black box. Physical disassembly of the black box is not required to find this secret command.

A.4 Power

The black box can be powered from a female XT60 connector or by the USB port on the Arduino Nano. The XT60 connector can accept a voltage between 5.5V and 30V. Therefore, the XT60 connector can be directly powered by the battery of the robotic solution. When the black box is powered by the XT60 connector, the USB port on the Arduino Nano can source up to 500mA at 5V for use by the robotic solution.

The black box also contains certain protective measures. The XT60 has protection against inverse polarity, in other words, the positive and negative wires are inverted. However, there is no fuse, therefore it is essential to respect the power limit on the USB connector of the Arduino Nano.

A.5 LEDs Connection

The LEDs that represent the spaces available for the passengers are connected to the black box via a three (3) pin terminal block. The white wire must be connected to GD, the red wire to 5V, and the green wire to LED_DATA. The LEDs are WS2811 type individually addressable LEDs.

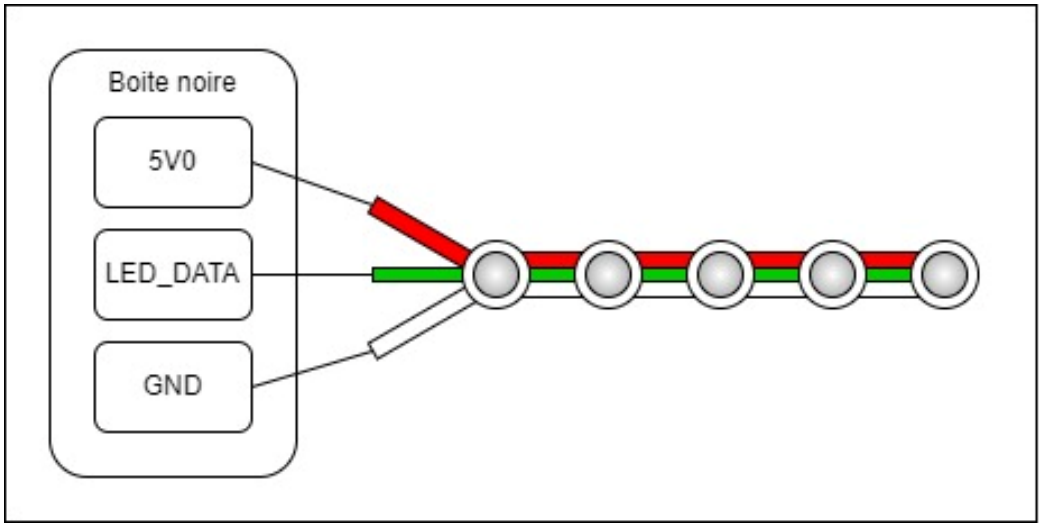

Figure A.4 – Connexion des LEDs à la boite noire

A.6 Reset

The black box can be reset, which means that the data related to the passengers can be cleared from the black box. To do this, press the reset button on the Arduino.

Appendix B

Nomenclature of Deliverable Submissions

University Names	Acronym
École de Technologie Supérieure	ETS
Polytechnic Montréal	EPM
Concordia University	CONCO
Laval University	UL
Sherbrooke University	UDS
University of Quebec at Chicoutimi	UQAC
University of Quebec at Rimouski & University of Moncton	UQAR
University of Quebec at Trois-Rivières	UQTR
UQTR in Drummondville	DRM
University of Quebec at Abitibi-Témiscamingue	UQAT
University of Quebec in Outaouais & Ottawa University	UQOT
MgCill University	MCGILL

Appendix C

Procedures from the Previous Year (for reference)

Important!

The following section is an excerpt (without changes) from the logistical procedures of the 2024 Engineering Games. This section is for reference only until the official procedures for the 2025 edition are released. The information in the 2025 Machine Logistics Booklet will take precedence over the information below.

Please disregard the names of locations mentioned in this section.

C.1 Machine Periods

The machine periods will take place in a common room at the hotel. The purpose of these periods is to carry out the final tests and adjustments on the machines in preparation for the final, as well as to have the chance to test them on the official course. Here are a few guidelines to keep in mind for these periods:

- A maximum of 4 people per university can be in the machine room at any one time.
- Sufficient worktables and power outlets will be made available to teams.
- Teams are encouraged to bring their own course for testing, and to allow other teams to use it.
- Heavy work is prohibited (use of angle grinders or any other tool deemed dangerous).

C.2 Tests on the official course

As the final of the entrepreneurship competition will take place on the morning of Saturday, January 6, the official field tests will take place on Friday evening at the Granada Theatre. A maximum of 4 people will be able to enter the theater and will be transported there by bus. One test in real conditions with a referee and scoring will be allowed per team for the entire period. Teams may stay until the end of the period if they wish. The means of return transport has yet to be confirmed, but it will be possible for teams to return to the hotel once their trial has been completed. Furthermore, given the circumstances, teams are asked to

bring only essential equipment with them, and to leave bulky toolboxes in the machine room. Tables and electrical outlets will be provided for teams.

C.3 Presentations

Presentations will take place in a room adjacent to the Granada Theatre. A maximum of 4 people per university may take part in the presentation. These members will need to take an early bus to make their presentations from 8 am. The machines will probably be accessible to bring to the presentation but should not be necessary for its smooth running.