Robotics for Good Youth Challenge 2024-2025

Theme of the Challenge

Global climate changes are intensifying the risk and severity of large-scale natural disasters, such as excessive heat, persistent drought, and other extreme phenomena, including torrential rains, landslides, flash floods, earthquakes, hurricanes, and wildfires. These tragic events necessitate a rapid and accurate response to find and rescue survivors when every minute counts.

In response to these crises, robots can provide a swift and precise solution. They limit human exposure to hazardous emergencies and make aid delivery safer, more efficient, and cost-effective. Notably, these robots utilize carbon-neutral energy sources, aligning with global sustainability goals.

Robots can significantly expedite search and rescue operations. With their assistance, emergency service managers can access geological maps, damage assessments, and facilitate rubble removal and medical supply delivery more accurately.

Technology and artificial intelligence also offer crucial support to first responders in perilous situations like fires, natural disasters, and other emergencies. Specialized robots, capable of navigating hazardous environments, limit the need for human intervention. They not only facilitate the rescue of survivors but also enhance the safety of emergency professionals.

These robotic capabilities can optimize response times, spur innovation, and crucially, save lives. When faced with such intricate challenges, advancements in robotic technology translate to improved response capabilities in emergency situations and disaster management.

Recognizing the significance of this issue, the Robotics for Good Youth Challenge 2024-2025, based on the ROBOCAT 2024, has a primary focus on natural disasters, particularly earthquakes. Seismic risks necessitate prediction work, soil and subsurface studies, and seismic-resistant construction standards. However, when an earthquake strikes, immediate intervention is crucial to mitigate its destructive effects.

International aid reflects solidarity for populations affected by disasters, like those resulting from geological risks. Robots equipped with infrared and thermal cameras, microphones, and sensors provide crucial assistance in locating people in danger. They relay vital information to rescue teams from initially inaccessible locations, acting as a critical link between survivors and emergency services.

These robots contribute significantly to the rescue mission, reducing the risk to human teams, especially in situations with partially collapsed buildings. For instance, robots with gas sensors can alert rescue teams of explosion risks from damaged gas pipelines. They can also assist in subsequent recovery efforts in the affected areas.

The competition encourages participants to design a robot centered around managing a seismic emergency, while reflecting on the current and future state of robot technologies and their application in disaster situations.

We urge the younger generations to contemplate and create new possibilities for robotics in disaster response. Participating teams can contribute to developing innovations, which are much needed in the field of prevention, prediction, rescue, and recovery in affected populations.

Mission for the Teams

The National Seismological Institute has reported a devastating 7.2-magnitude earthquake in the capital. Your rescue team, renowned for its expertise and innovative technology in rescue operations, has been summoned by the municipal emergency coordinator to assist with rescue and evacuation efforts. Without a second's hesitation, you spring into action, preparing to intervene. En route, you receive the situation report:

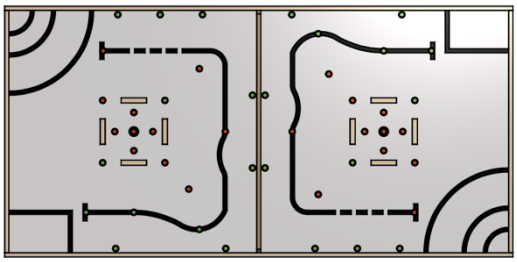
1. The city is located near a geological fault, and it has already experienced earthquakes of lesser magnitude. Due to this, most of the buildings have been constructed using techniques that make them resilient to earthquakes and have not suffered significant damage.
2. The foundations of one of the apartment blocks closest to the epicenter have suffered severe damage. The building could not withstand it and has collapsed. Most of the residents have been able to escape, but some have been trapped. First response teams estimate that there are 9 people under the rubble and potentially injured.
3. Due to the earthquake, several communication routes have been damaged. Engineers and workers are already on their way to repair them, but it will take some time, and therefore, you cannot count on external help.
4. Some buildings have suffered minor damage. Firefighters will inspect the buildings to ensure they are safe, but until then, the inhabitants must be evacuated to the designated shelter.
5. Some pipes have broken and caused holes in the roads. Between this and the rubble, some streets have become impassable. Evacuees cannot reach shelters, and ambulances have difficulty picking up the injured. Engineers and workers are already on their way to repair them, but it will take time, and time is pressing.

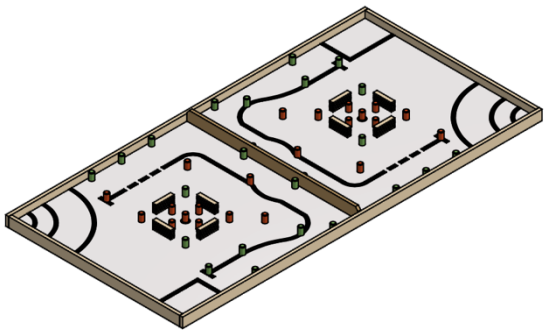
Your team is tasked with rescuing the individuals with critical injuries, both within and outside the affected building, and transporting them to the hospital. Simultaneously, you are responsible for evacuating the remaining unharmed individuals to the designated shelter. While executing this mission, it is imperative to exercise utmost caution, as several structures have suffered significant structural damage and may collapse. Therefore, meticulous maneuvering is crucial to prevent further damage that could pose additional risks to the affected individuals.

Materials for the Game

1. **GAME BOARD**. The Game Board is where the Robot Game takes place, and it is divided in two Competition Fields, one for each team. Specifications:
    a. Elements
        i. Game Board surface: 2362±5 x 1143±3 mm.
        ii. Each Competition Field surface: 1171±6 x 1143±3 mm
            1. Medium-density fiberboard (MDF). Wood that has a density of between 550 and 750 kilograms per cubic meter
            2. Painting: water-based acrylic paint
                a. White: RGB 255, 255, 255 CMYK 0, 0, 0, 0 Pantone N1797C RAL 9010 BS 389C

iii. Two long border walls: 2402±5 x 20±1 x 65±2 mm
    1. Material (suggested): two-by-three
iv. Two short border walls: 1143±3 x 20±1 x 65±2 mm
    1. Material (suggested): two-by-three
v. Central wall separation between the two Competition Fields: 1143±3 x 19±1 x 70±3 mm

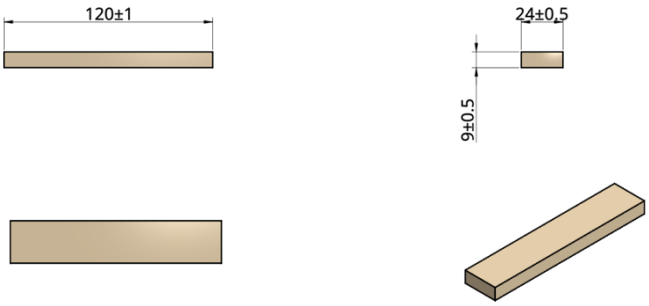




2. **RED WOODEN BLOCKS**. Specifications for one Competition Field:
    a. Number: 11
    b. Type: wood
    c. Dimensions: 30 x 30 x 50 mm (length, width, height)
    d. Painting: water-based acrylic paint
        i. Red: RGB 255,0,0 CMYK 0,100,100,0 Pantone 185C RAL 3003 BS 25 603

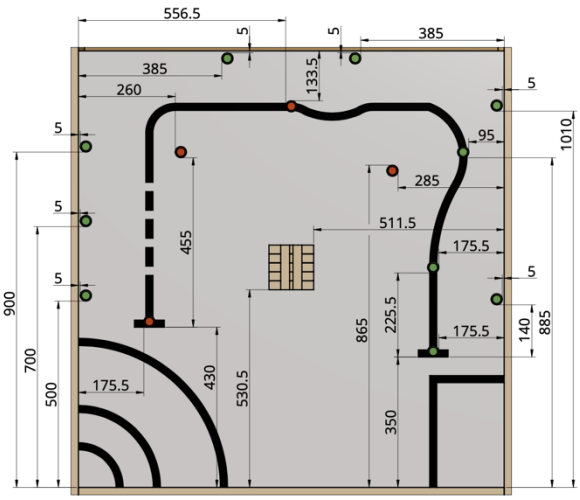
3. **GREEN WOODEN BLOCKS**. Specifications for one Competition Field:
    a. Number: 12
    b. Type: wood
    c. Dimensions: 30 x 30 x 50 mm (length, width, height)
    d. Painting: water-based acrylic paint
        i. Green: RGB 0,255,0 CMYK 100,0,0 Pantone 355C RAL 6002 BS 25 623

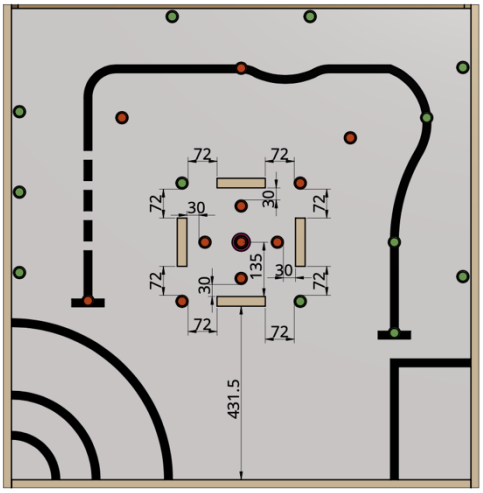
4. **BROWN WOODEN BLOCKS**. Specifications for one Competition Field:
    a. Number 48
    b. Type: wood
    c. Dimensions: 120 x 24 x 9 mm (length, width, height)
    d. Painting: water-based acrylic paint
        i. Brown: RGB 165, 42, 42 CMYK 0, 46, 73, 27 Pantone 7421C RAL 8001 BS 381C
    e. Placement: 12 on top of the other, forming 4 blocks in the middle of the Competition Field.



Position of the red, green and brown wooden blocks

Note: only use the following designs for the placement of the wooden blocks. For the wooden blocks located in the middle of the Competition Field, please only consider the one located in the right.





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5. **HOSPITAL**

   Hospital Roof (1). Specifications for one Competition Field (in mm)

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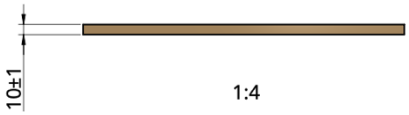

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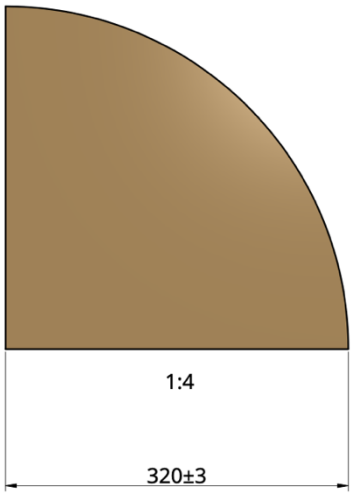

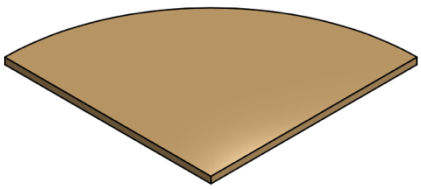

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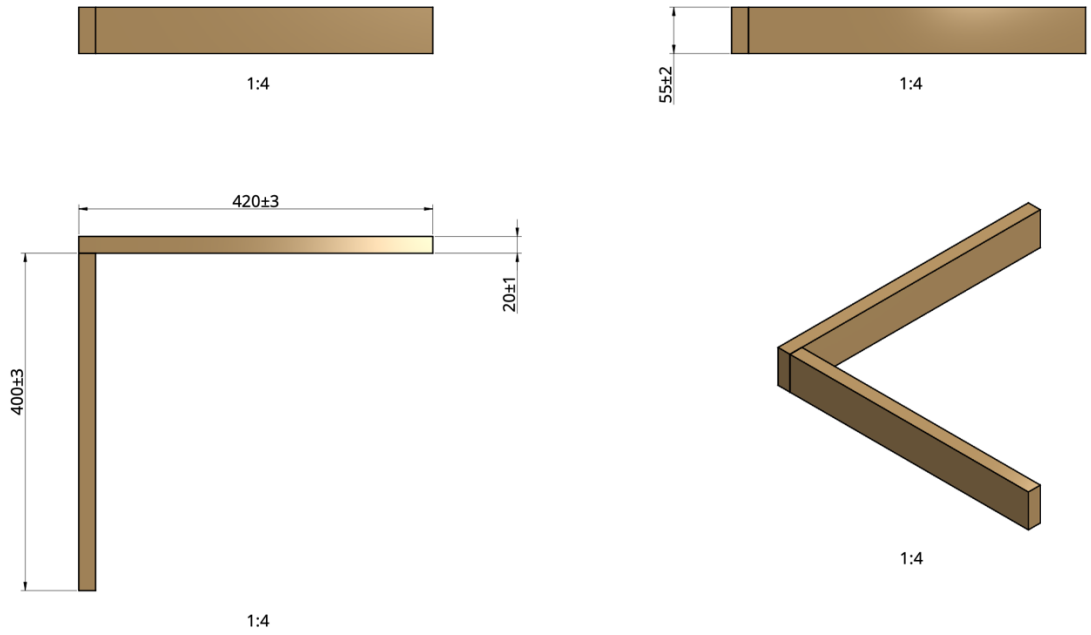
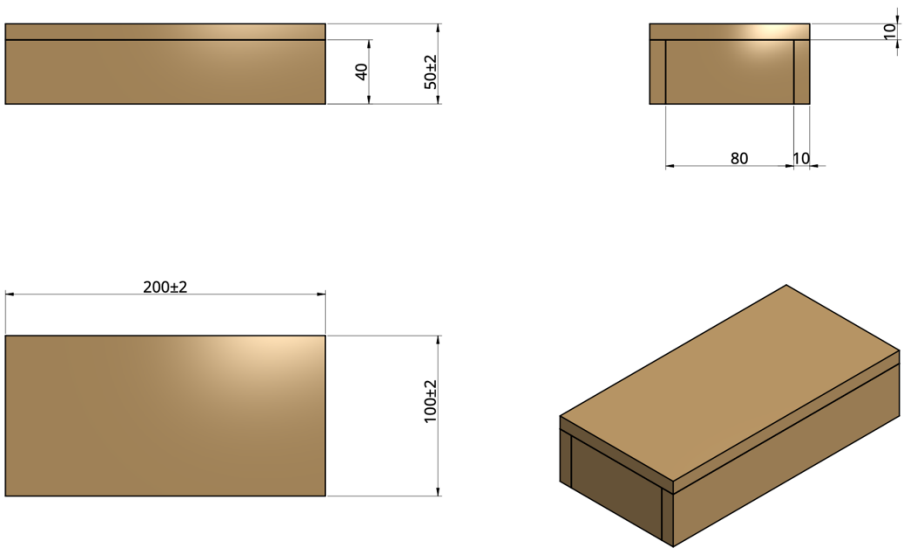
Hospital Laterals (2). Specifications for one Competition Field (in mm)

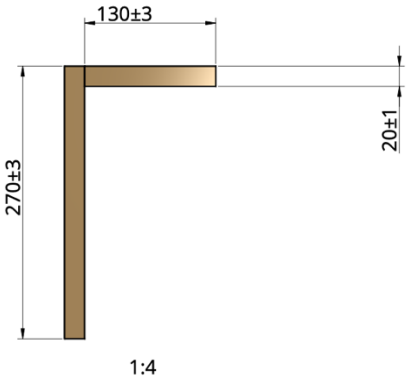


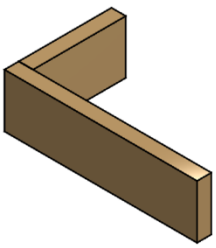
6. **REFUGE**

Refuge Structure (1). Specifications for one Competition Field (in mm)



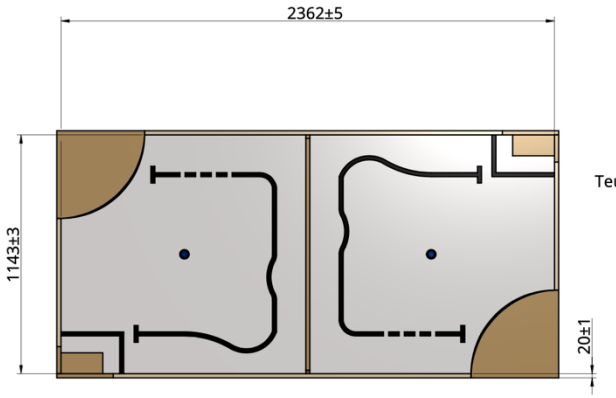
Refuge Superior Laterals (2). Specifications for one Competition Field (in mm)

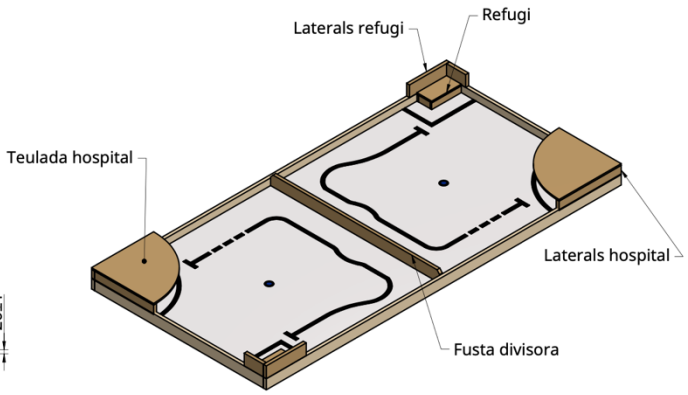




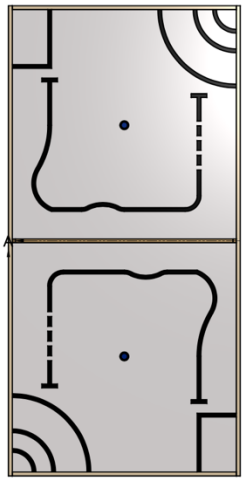
Location of the hospital and refuge in the Game Board

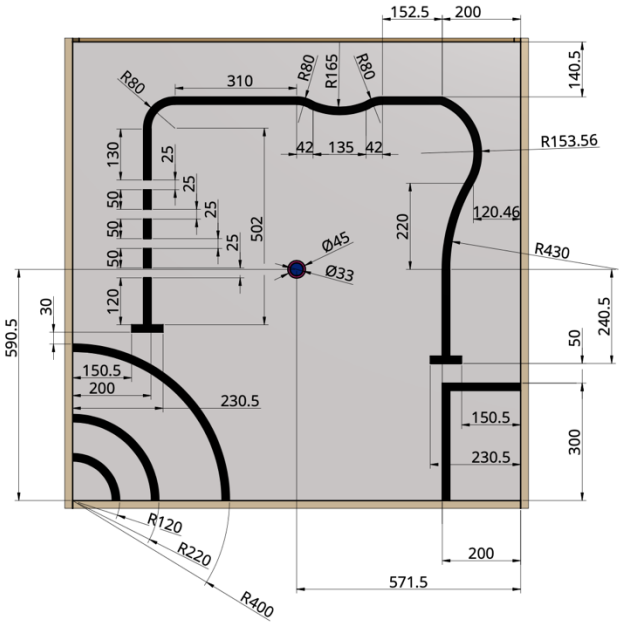
Note: the dimension of the roof is smaller than in the image.





7. **PVC tape**: Specifications for one Competition Field (in mm)
    a. Material: Polyvinyl chloride (PVC)
    b. Thickness: 19mm
    c. Width: 10mm
    d. Color: black





Robot Game Rulebook

Game Board

T1. The Game Board is rectangular and is divided into two Competition Fields separated by a wall positioned in the middle of the longest side, which we will call "*Mountain*". **Throughout the Robot Game Rulebook, the mountain is referred to as viewed from the shortest side of the board**.

T2. The "*Refuge*" is located in the lower right corner of the field, which consists of two levels. The first is at ground level, delimited by a black rectangle. The second is raised on a wooden block. Both areas have no height limit; all the airspace is considered part of the corresponding area.

T3. In the lower left corner of the field is the "*Hospital*", in the shape of a quarter circle. It is made up of ground areas delimited by color stripes and a roof.

T4. Between both zones is the "*Start Zone*", which extends 30 centimeters measured from the shortest side and has as its limit the area of the hospital and the refuge. The "*Start Zone*" is not marked.

T5. In the center of the Competition Field is the block of flats, which is already demolished forming a predefined pattern, as shown in the images.

T6. Around the block of flats, connecting the refuge with the hospital, a circuit which we will call "*road*" is located. The blocks are placed on and around the circuit as defined in "*Operation of the Challenge*".

Robots

R1. Each team must present at least one robot. There is no maximum number of robots that can be put into play, but the limitations on the initial position of the robots in "*Operation of the Game*" must be taken into account.

R2. Robots can be built with any kind of material and can be programmed with any desired platform.

R3. Robots must be entirely built and programmed by the team members. Participants can count on the occasional help of coaches or outside people, but they are the ultimate responsible for the robots. Referees may ask about the operation and decisions made during the competition and participants are expected to know how to answer.

R4. The robot must be decorated around the topic “disaster response” to pass the homologation. The homologation will consist of a visual inspection and, if necessary, the team's justification for the reasons for the decoration.

   a. If multiple robots are presented, all of them must be decorated.

R5. Robots must be completely autonomous, that is, during the game the team can only interact with the robots to start and stop them.

   a. A robot can use an external support (laptop, tablet, remote, etc.) for activation and deactivation. Communication with the external support must be wireless (Bluetooth, RFID, infrared...) and the device must be operated by one of the team members present at the “*Competition Area*”. Once the robot or robots are turned on, the device must remain out of the reach of the participants until they decide to stop it. Taking the device for any other purpose will be considered illicit manipulation of the robot.

R6. A maximum size is not defined for a robot, but the limitations on the initial position and valid movements of the robots in "*Operation of the Game*" must be taken into account.

R7. Robots must not pose a risk to people, competition facilities, or the integrity of competition materials. In case of non-compliance, the team will be required to repair deficiencies immediately. If they are not repaired, or if it represents a serious danger, the robot would be removed from the facilities and the team, expelled.

Operation of the Round

P1. Before starting the Game, a preparation time will be established. During this time, the team must:

   a. Place the robots turned off on the Competition Field.
   b. Review the condition of the Competition Field.
   c. If they find that the Competition Field does not meet the specifications of the Rulebook, they must report the discrepancies to the referee so that they can be corrected. Once the Game has started, the Competition Field cannot be altered.

P2. Robots must be placed completely within the “*Start Zone*”, and the set of robots, in the initial position, must fit within a 54 x 30 cm rectangle. *Note: the “Start Zone” is larger than this rectangle by three millimeters (54.3 cm x 30 cm). Therefore, placing a robot in the lower right corner and one in the lower left is not a valid starting position*.

P3. All robots must always remain completely within the Competition Field limits.

P4. At the start of the Game, the team must activate all the robots. If the team decides not to activate a robot, or if it cannot be activated, the robot must remain off and in the same position it was left until the end of the Game.

a. A robot is active when it starts processing its orders and no longer requires human intervention. It is not necessary for a robot to start moving immediately.

P5. The start of the Game must be after the stopwatch starts counting, and before time runs out. The team is not obliged to start the game just when the stopwatch starts. *This rule is designed to allow a later start in case of technical problems and false starts, we do not recommend using it for other reasons*.

P6. If during the activation of the robots, one of them moves while the team is handling the robots, it will be considered a "*False Start*". If the team presents multiple robots and one of them fails to activate, a false start can also be declared. During a false start:
   a. All robots that have already been activated must be deactivated and returned to their initial position. It is not possible to change the initial position of the robots during a false start.
   b. The condition of the Competition Field that has been modified must be restored to its initial state.
   c. When the previous steps are completed, the team can try to start again.
   d. The stopwatch will not stop or restart during a "*False Start*".
   e. If both teams make a "*False Start*", the organization may, at its discretion, restart the stopwatch.

P7. The Game will end when the team decides it, when the time marked by the stopwatch runs out, or when it is forced as a penalty for non-compliance with the Rulebook, as detailed in the "*Penalties during the Game*" section.
   a. Once the Game is over, it cannot be resumed.
   b. When the Game ends, <u>all</u> robots must be stopped without any delay. Once stopped, the robots must remain in the same place where they were at the end of the game until the scoring is finished.
   c. The different elements modified after the end of the Game must be reversed before a new Game starts.
   d. The team can implicitly end the Game by stopping a robot. In this case, it will be considered that the Game ends when a team member touches the robot, or the associated wireless control device. In this case, the team must also stop the rest of the robots, as stated in paragraph (b).

P8. During the Game, any communication with the robots that does not result in immediate shutdown is prohibited. This includes, for example, manipulating the field conditions to trigger another robot sensors.

P9. Neither the team nor the robot can damage the Competition Field or its objects. In case of non-compliance, it will proceed as detailed in the "*Penalties during the Game*" section.

Operation of the Game

The challenge consists of several missions to locate and transport items of interest during a **2-minute Game**.

F1. Within the ruins of the apartment block, in the middle of the field, there are 9 people, 7 "*wounded*" (represented by **red wooden blocks**) and 2 "*evacuated*" (represented by **green wooden blocks**). The block may have marks on the corners to identify their origin.

F2. Along the road, there are 4 "**wounded**" and 10 "**evacuated**". These blocks cannot have marks on the corners. The location of these blocks and their distribution is fixed.

F3. Each **red wooden block** will get the following “Initial Score” based on its position at the end of the Game:

   a. 8 points if it is completely inside the “*Hospital Consultation Room*”, not including the bands that delimit it.
   b. 6 points if it is partially inside the “*Hospital Waiting Room*”, including the bands that delimit it.
   c. 2 points if it is on the “*Hospital Roof*”. It must be partially within the hospital's airspace, not including the space under the roof.
   d. 0 points if it is partially inside the “*Hospital Parking*”, including the band that delimits it, or if it is not included by any of the previous rules, then being outside the “*Hospital*”.

F4. Each **green wooden block** will get the following “*Initial Score*” based on its position at the end of the Game:

   a. 4 points if it is on the upper level of the “*Refuge*”. It must be partially within the airspace of the upper level of the “*Refuge*”.
   b. 2 points if it is partially inside the lower level of the “*Refuge*”, including the bands that delimit it.
   c. 1 point if it is in the “*Hospital Waiting Room*”, the “*Hospital Consultation Room*” or the “*Hospital Roof*”, limiting these areas in the same way as if it were a red wooden block.
   d. 0 points if it is in the “*Hospital Parking*”, or if it is not included by any of the previous rules, then being outside the “*Refuge*” and the “*Hospital*”.

F5. A wooden block stands upright if it is completely perpendicular to the ground. An upright wooden block will get a bonus of 1 point on top of its “*Initial Score*”, as long as it is above 0 points. A cork with a “*Initial Score*” of 0 points does not admit this bonus.

F6. A wooden block from the building will multiply its score by 2.

   a. If, in addition, the wooden block is upright (according to the corresponding rule), the bonus for being upright will be applied first, and then the multiplier.

F7. All wooden blocks must be completely inside the Competition Field to score. Those that are not will not count for scoring purposes.

F8. Discarded wooden blocks will always count 0 points. A wooden block is discarded if:

   a. It is in contact with the robot or with any foreign piece (i.e., that does not belong to the Competition Field). If the referee doubts whether it is in contact, he may remove the robot or the piece. If the wooden block remains in its position, it was not in contact and it will be taken into account for scoring purposes.
   b. It is partially outside the Competition Field. The field does not include the woods that delimit it.
   c. It is in contact with the highest side of a discarded wooden block. If the referee doubts whether it is in contact, he may remove the lower wooden block. If the upper one remains in its position, it was not in contact and a recount will be proceeded.

F9. The final score of the Game is the sum of the scores obtained by the wooden blocks, counting possible bonuses.

Competition structure

C1. The competition will be divided into Qualifying Rounds and Elimination Rounds.
C2. During the Qualifying Rounds, two teams will be randomly paired in each match.
C3. Each team will play, on average, once per Qualifying Round, and never more than twice.
    a. When the organization considers it necessary, a team will be randomly selected to postpone its participation in that Qualifying Round. That team will not play during that Qualifying Round, but will play twice in the next Qualifying Round. *This process must be followed when there is an odd number of teams.*
    b. If a team has to play twice during a Qualifying Round, it will play the first time at the start of the round and the second time at the end.
    c. As a result of these rules, at the end of all Qualifying Rounds all teams will have been able to play the same number of times.
C4. When the Qualifying Rounds are over, the ranking for the Elimination Rounds will be made, according to the score obtained, in the following way:
    a. Firstly, the teams will be ranked by the highest score obtained during the Qualifying Rounds, in descending order (the higher, the better).
    b. In case of a tie, they will be ranked by the number of absences, in ascending order (the lower, the better).
    c. In case of a tie, they will be ranked by the sum of the scores obtained during the qualifying rounds, in descending order (the higher, the better).
    d. Finally, in case of a tie, it will be randomly decided between the tied teams.
C5. For the first Elimination Round, pairings will be made so that the top-ranked team faces the last-ranked team, the second-ranked team against the second-to-last team, and so on. Those teams that cannot be ranked will not continue playing.
C6. During the Elimination rounds, the team that obtains the highest score in each Game will move on to the next round.
C7. When the two semi-final matches have been played:
    a. The teams that lost the semi-finals will face each other. The winner will receive the 3rd prize of the Tournament.
    b. The teams that won will face each other to decide the 1st prize (winner) and the 2nd prize of the Tournament.

Penalties during the Game

P1. If a team does not show up with enough notice before a match to prepare, it will be considered that the team is absent.
    a. Absences will not count towards scores, and will be noted for tiebreaking purposes.
    b. The organization will define how much notice is needed to prepare for the match.
    c. Exceptionally and duly justified, the organization may decide to postpone a match.
    d. *Matches can very rarely be postponed, so do not count on this. Make sure you have the robot with the correct program, charged batteries and all the pieces you need before the match.*
    e. *If you believe you will have scheduling restrictions on the day of the tournament, send an email to the organization before the day of the tournament to find a solution.*
P2. If a team presents an unhomologated robot, it will have to be removed from the competition field and cannot be used.

P3. If the referee believes that a robot has been substantially modified since it was homologated, he/she can carry out an emergency homologation. If deficiencies are found in this homologation, it will be considered that the robot has not been homologated.
P4. If a team shows up without an homologated robot, it will be considered an absence.
P5. If the preparation takes longer than the time expected in the competition, the organization may, with prior notice, start the stopwatch before one or both teams are ready.
P6. As a result of a sanction, a match can be "rejected". In this case:
    a. If it is still being played, it will be terminated immediately.
    b. The resulting score at the time the match is terminated will be counted.
    c. If the sanctioned action has altered the score, it will be counted as if the action had not occurred. In case of doubt, the least favorable score for the team will be applied.
    d. The final score of the team, if positive, will be set at 0. In other words, the maximum score for the rejected match is 0.
P7. If the team manipulates the robots or the objects on the field.
    a. Very serious offense if it occurs with the intention of deceiving the referee or significantly altering the result of the match.
    b. Serious offense in other cases.
    c. In case of a very serious offense, a penalty of 200 points will be applied and the match will be rejected.
    d. In case of a serious offense, the match will be rejected.
P8. If there is interference with the other field or the other team.
    a. Minor offense, if the interference does not affect the conditions of the other team. In particular, if it does not interact with the robots (directly or indirectly) or the objects of the opponent, or if the referees manage to restore the previous conditions before it affects the match (for example, by removing foreign objects).
    b. Serious offense, if it affects the other team.
    c. Very serious offense, if the interference is part of a deliberate strategy with the aim of harming the other team.
    d. The minor offense carries a penalty of 50 points.
    e. The serious offense carries a penalty of 100 points. In addition, the other team can be scored as if the interference had not occurred. In case of doubt, it will be calculated as if the immediate action that the robot was making at that moment had been successful.
    f. The very serious offense carries a penalty of 200 points and the match will be rejected. The other team can be compensated as in a serious offense.
P9. If the physical characteristics of the board or the objects are damaged or altered.
    a. If the affected object has consequences in terms of scoring, it will be counted as if it had been removed from the field.
    b. This offense carries a penalty of 100 points.
    c. If the damages compromise the safety of the field or prevent the game from continuing, the game will be stopped immediately, without the right to repetition. The opposing team, if also affected, can replay the game or keep the score they had achieved until the end of the game.
    d. In any case, the organization reserves the right to claim compensation for the repair of the damages caused.
P10. If the roof of the hospital has been removed at any point during the game, the score for the caps in the hospital will be the minimum between the score they have obtained in their position, and the score they would have obtained on the roof of the hospital.
P11. If during the game a robot, a piece or an object from the field goes out of the field limits.

a. If a piece or object completely leaves the playing field, it will be considered "withdrawn" and the referee will have to pick it up. If a robot reintroduces the object, the referee will remove it as soon as possible with minimal impact, but the team will not be compensated for the side effects of this removal.
b. If a robot completely leaves the playing field, it will have to be stopped, but it is not necessary to end the game.
c. If a piece, an object or a robot partially exits the playing area, a penalty of 50 points can be applied. The referee can decide not to apply the penalty if he believes that the exit was minimal and accidental, or if the team has already been harmed in terms of scoring.

Sanctions during the Competition Day

Se1. A disqualified team will not be able to play any more games. In addition, it will not be considered to move on to the next round and will lose any awards or mentions that it has obtained.

Se2. If the team does not arrive in time to register before the registration closing time, it will be disqualified.
a. The registration closing time will be specified the day before the competition, and it will always be within the event's schedule.
b. The organization can make exceptions. If you believe you will not arrive on time, send an email in advance.

Se3. If a coach or mentor accesses the areas restricted to participants outside of the enabled hours, he will be expelled from the restricted area and will be warned that his behavior is punishable. If he persists in non-compliance, the team may be disqualified.
a. The hours during which coaches or mentors can be in restricted areas are before the opening ceremony and after the closing.

Se4. If a person (even if they are not the coach or mentor) contacts the team participants, physically or through any other means, in order to give technical instructions about the robot, a member of the organization will notify the parties involved that this behavior is punishable. If he persists in non-compliance, the team may be disqualified.
a. This rule does not apply between participants in the same competition. Collaboration between teams is encouraged.

Se5. If the two previous rules are violated simultaneously, the team may be directly disqualified.

Se6. If a person who is not a coach or mentor accesses areas restricted to participants, they will be returned to the public areas and, if appropriate, expelled from the competition venue.

Se7. If a team member disrespects any participant, coach, member of the public, or member of the organization, the incident will be reported to their coach and the organization will take appropriate measures, which may include the expulsion of the participant or disqualification of the team.

Se8. If a team damages the facilities, or the materials of other teams, the same process as in the previous point will be followed.

Se9. If a team has been repeatedly sanctioned, it may be called to a meeting with the organization. If it is considered that the team shows disregard for the rules, it may proceed to its disqualification, or the expulsion of some of its members.