



**AGRICULTURAL UNMANNED
GROUND VEHICLE
COMPETITION SPECIFICATIONS
2024**

1. PURPOSE OF THE COMPETITION

The Agricultural IKA Competition is a competition to develop agricultural technologies with unmanned ground vehicles. The aim is for competitors to develop projects to increase productivity in agriculture with robots moving on land and to explore their contributions in the field of agriculture. The agricultural problem addressed in this competition is the cultivation of the soil (hoeing) and the detection of weeds by the projects to be developed. It includes all aspects of an unmanned agricultural robot project, from design to production and post-mission review.

The competition reflects various aspects of real systems, such as meeting communication requirements and developing an interdisciplinary system.

2. CONTEST SUBJECT

The IKA (unmanned ground vehicle) designed in the Agricultural IKA Competition is a robot system that can move autonomously in the field of agriculture without any problems, perform tasks that can increase agricultural productivity, and display information about these tasks in an interface environment.

3. GENERAL ISSUES ABOUT THE COMPETITION

The Agricultural RDA Competition consists of **four** stages;

Competitors must form their team in accordance with the rules of participation in the competition and the last application must be made through the KYS system (<https://www.t3kys.com/tr>) until **29/02/2024**. Details about the competition processes are specified in the relevant headings.

Phase One is the phase where the Technical Qualification Form is prepared. Teams should develop their designs, prototypes, test concepts and report them using the Technical Qualification Form template provided to them.

The second stage is the stage where the Critical Design Report (CDR) is prepared. Teams will finalise their designs and start ordering their components and production parts at this stage.

Test results of equipment and subsystems will be included in this report. The report should be reported using the Critical Design Report (CDR) template shared with the teams.

Third Stage; It is the stage where the movement - capability video is prepared. Teams will complete their designs and it must be shown that the vehicle can move from one point to another point on the ground in a voluntary and balanced manner. The following items can be given as examples of unacceptable movements.

Crushing the plants on the soil ground, performing involuntary and independent rotation / travelling in the axes of movement and independent of the direction of movement

External control for autonomous vehicles (external to autonomous software)

Videos where the image and movement of the vehicle is not clear

All teams have to present the videos of their Agricultural UGVs to the jury **online** before the final competition. Teams that do not submit a video lose the right to compete in the final.

The fourth stage is the time of the final show of the competition. The Agricultural UGVs

prepared by the competitors will be shown on the competition track. All scoring and evaluation results are final. The evaluation results will be shared with the teams in a quantitative format in order to minimise ambiguities and to enable the teams to see their own shortcomings.

Team members must be present at all stages and come to the competition area and their prototypes must be ready in order to receive a participation certificate and award.

4. COMPETITION CALENDAR

The general outline of the competition plan is as follows;

HISTORY	EXPLANATION
29.02.2024	Competition Application Deadline
19.03.2024 – 22:00	Technical Qualification Form Deadline
29.03.2024	Announcement of the Qualifying Teams according to the Technical Qualification Form Results
10.05.2024	Critical Design Report (CDR) Deadline
31.05.2024	Announcement of Critical Design Report (CDR) Results, Financial Support Winners and Finalists
02.07.2024	Movement and Capability Demonstration Video Deadline
04-07.07.2024	Video Presentation Phase
August - September 2024	Competition Date

Table 1 - Competition Calendar

5. TEAM STRUCTURE

Associate, undergraduate and graduate students and/or graduates studying in Turkey and abroad can participate in the competition in teams consisting of **at least 3 people and at most 10** people.

The role of the counsellor;

- Provide laboratory resources, working classroom/room/environment and teleconferencing facilities for the team,
- Directing the team leader and the team.
- To submit the documents prepared by the team to the competition commission.

The counsellor must not;

- To design or directly propose a design.
- Advising more than one team for this competition.
- Managing the operation on the day of the competition,
- Each team should have a "Team Leader" elected from among the members. Duties; To ensure coordination and information transfer between the team and the advisor.
- To ensure communication with the competition officials.
- To carry out the project and ensure coordination within the team. Each team will be

given a team number by the competition committee.

6. COMPETITION PARTICIPATION CONDITIONS

- Associate, undergraduate and graduate students and/or graduates studying in Turkey and abroad can participate in the competition.
- Teams must consist of **at least 3 and at most 10 people**. Apart from this, teams can only take 1 person as a counsellor.
- Each team must have at most one counsellor.
- Teams can be formed from a single school or a mixed team of one or more higher education students.
- In case of a change of advisor, they must notify the relevant TEKNOFEST Competitions Committee in writing. (It is mandatory to submit this document to change the advisor).
- The counsellor should not be included in the role of team member.
- Applications are made online via www.t3kys.com application system until **29/02/2024**.
- Between the application dates, the team captain/advisor registers through the system, makes the registration of the advisor and/or team captain/team members, if any, in the system correctly and completely, and sends an invitation to the e-mails of the advisor and members, if any. The member to whom the invitation is sent logs into the application system and accepts the invitation from the "My team information" section and the registration is completed. Otherwise, the registration is not completed.
- Competitors who have completed the team formation process must apply to the competition suitable for their project.
- All necessary processes within the scope of the competition (Application, Report Receipt, Report Results, Financial Support Application, Appeal Processes, Member addition / removal processes, etc.) are carried out through the QMS system. Teams are required to follow their processes through the QMS system.
- Member additions/removals are made until the Critical Design Report Delivery date.
- Throughout the competition process, making applications, uploading reports and filling out forms via KYS are within the authority of the team captain and/or advisor and the competition processes are managed through these persons.
- The transport and accommodation support to be provided to the finalist teams is limited. The number of people to be supported will be announced to the competitors by TEKNOFEST Competitions Committee.
- TEKNOFEST Organising Committee has the authority to limit the number of members in the festival area. In case of limitation, the committee will be informed by the committee.
- The competitor will be able to participate in the competition by reading and approving all explanations about the competition and the conditions of participation before applying.
- Project ideas must not be copied. Projects found to be similar or imitated will be excluded from the competition. If the competitor has previously participated in another competition with the same project, the name, place, date, organiser and the result of the competition must be reported in the project file.

- Only one category or one competition can be applied with the same project. The applications of teams or individuals applying to different categories or different competitions organised within the scope of TEKNOFEST with the same project will be deemed invalid.
- Applications are made online through the application system www.t3kys.com until **February 29, 2024**.
- Applicants are deemed to have accepted all of the above conditions.

7. TECHNICAL REQUIREMENTS/NECESSITIES

- The Agricultural UGV to be designed must be able to complete the track until the end of the time it competes.
- Agricultural UGV must have an energy system on board, sufficient to complete the track. The energy source can be electricity, petrol or any other available method used.
- The dimensions of the agricultural unmanned land vehicle to be designed (Agricultural UGV) should be decided by examining the track.
- The Agricultural UGV must be a vehicle that has autonomous mobility and is not interfered with by an interface system or an external control.
- The interface system should be able to instantly show the user the operations performed by Agricultural UGV (battery level, the mission performed, the road travelled in the field of agriculture, etc.).
- Agricultural UGV should have an emergency stop button in an accessible location that will cut the power to the entire system.
- All electronic equipment and mechanical parts to be assembled by Agricultural UGV must be assembled by fixing them by using suitable joiners such as connectors, screws and high performance adhesives.
- It should be ensured that Agricultural UGV completes the demonstration undamaged.
- Agricultural UGV should be able to detect weeds on the track and between the rows within the given time.

8. GENERAL INFORMATION ABOUT THE COMPETITION

Evaluation will be carried out in four different stages: Project Technical Form, Critical Design Report, Mobility Video and Competition Scoring. A total of one form and one report will be prepared within the scope of the competition. Teams **that do not submit** Project Technical Form, Critical Design Report and Mobility Video will not be eligible to participate in the competition.

8.1. Technical Qualification Form

Preliminary system designs are made in the Technical Qualification Form phase. The Technical Qualification Form is an **"interdisciplinary" review form that includes a detailed description of the agricultural problem, the relevant sectoral data, how this problem will be solved, the cost (programme budget), work plan (programme schedule), risk and other system constraints of the designed preliminary systems that can meet the specified performance requirements; to decide on the final detailed design.** At the end of this form, preliminary design is decided. When the Critical Design Report (CDR) phase is started, the details of the determined design are made.

Teams are obliged to submit their Project Technical Forms on the date specified in the Competition Calendar. Detailed information about the submission of the Project Technical Forms will be shared with the teams that have completed their application after the end of the competition application date. A pre-qualification will be carried out according to the results of the Technical Qualification Form. The Technical Qualification Form template will be shared on the website (<https://www.teknofest.org/>) in the following process. As a result of the preliminary evaluations, the teams that have passed to the second stage will be announced on the date specified in the Competition Calendar.

8.2. Critical Design Report (CDR)

In the CDR phase; the detailed design of the system decided in the Preliminary Design Report, the tests of the equipment are carried out as planned and the integration plan of the subsystems is shown. The Critical Design Review Report is a review report prepared to see whether the interdisciplinary performance requirements specified within the cost (programme budget), work plan (programme schedule), risk and other system constraints are met.

The Critical Design Review Report to be prepared for the Agricultural RDA project should include the following items;

- Overview of mission operations,
- Description of the operations management of Agricultural UGV and the payload,
- Detailed design and analysis results for each subsystem
- How to verify (Test, Analyse, Design Review and Inspectability) the detailed design requirements for systems, subsystems and equipment,
- Plans for equipment, subsystem and system level tests required for verification of requirements,
- The results of tests for the equipment,
- Installation plan of the equipment constituting the subsystems (for each subsystem),
- Results of subsystem tests, if performed,
- The integration plan of the subsystems that make up the system,
- Whether the results of verification tests (Subsystem tests must be completed.),
- Updated detailed work schedule (Completed works should be indicated),
- Shows the updated budget plan (will include purchase statuses; pending, in transit, received, returned, etc.).

The template for the Critical Design Report will be announced on the TEKNOFEST website at a later date. The report will be scored according to the headings to be shared in the CDR Evaluation template. The score obtained in the Critical Design Report Template will contribute to the total score of the competition.

Teams above the threshold score to be determined according to the results of the Critical Design Report will continue the competition and financial support will be given to the number of teams determined by the Competition Advisory Board and the Referee Panel. Other teams above the threshold score will continue the process without financial support

8.3. Movement and Mobility Video

The mobility and task demonstration video is an uninterrupted video showing that the vehicle to be participated in the competition can remain balanced and can move in the desired direction in a voluntary and balanced manner. Mobility demonstration video;

- That the Agricultural UGV of the team can move voluntarily and stably from one point to another on the dirt floor,

The following items can be given as examples of unacceptable behaviour.

- Performing involuntary and independent rotation/driving in the axes of motion
- External control for autonomous vehicles (external to autonomous software)
- Videos where the image and movement of the vehicle is not clear

The video should be in mp4 format and should not exceed 50 Mb in size. There must be parts showing that the agricultural UGV moves with the command given from its computer, does not get crushed by flowers, and can turn left and right according to the scenario. The video must be recorded in such a way that ambient sounds can also be heard. All teams have to present the videos of their Agricultural UGVs to the jury **online** before the final competition. Teams that do not submit a video lose the right to compete in the final.

General Considerations

It is expected to demonstrate the operation of the emergency stop button to be provided in the Agricultural UGVs. When the button is pressed (Magnetic or rotary emergency buttons are also accepted), it should be shown that all motors stop and the system switches off.

The resolution of the video should be at least 720p and the total duration should be **at least 2-3 minutes, maximum 5 minutes**.

In order to participate in the competition, the mobility video must be sent by the date specified in the Competition Calendar.

Videos will be uploaded to Youtube. Videos uploaded to other platforms will not be accepted.

8.4. Screening

8.5.1. Roles of Team Members at the Time of Screening

Team members should be assigned to roles at the time of the operation. For a successful operation, teams need to coordinate among themselves and with the competition coordinators. Team members should be assigned to specific tasks and develop a checklist for a successful demonstration. For example, a list of checks to be performed before starting the operation, a list of parameters and conditions to be observed during the operation and who is responsible for their control. Members of the team need to be assigned to the following tasks;

Operation Control Officer: Minimum one person. It follows Agricultural UGV in a close position in the test area and switches off the system in case of a problem.

Interface System Team: They have the task of recording the interface during the demonstration process and remotely intervening Agricultural UGV with the remote control according to the request of the judges.

8.5.2.Competition Event Sequence

The operation of the competition is as follows;

- Arrival at the competition area.
- Installation of the interface system to the allocated desks.
- Preparation of Agricultural UGV for demonstration and final test.
- The Interface System Team will verify that the interface system communicates with the RDA.
- The operation control officer will follow Agricultural UGV until the demonstration is completed.
- The screening will end.

8.5.3. Disqualifications

- Teams that copy content or design from other teams,
- Teams submitting documents with empty or meaningless content,
- Teams that do not comply with the security measures to be taken on the day of the screening,
- Teams that sabotage the work of other teams and the demonstration process,
- Individuals or teams participating in the agricultural UGV competition cannot participate in the agricultural technology competition with their prototypes in the agricultural IDA competition. The jury has the right to eliminate the teams participating in the agricultural technologies competition with the same prototype.
- Teams that do not submit any of their reports during the competition process, teams that behave in a way that disrupts the peace of the competition or competition officials before, during and after the competition, teams that show unethical behaviour verbally or in writing (including social media) will be disqualified.

9. RULES AND REFEREE BRIEFING

9.1. Rules

- Agricultural UGV, which will compete, must complete the track.
- After Agricultural UGV has taken office, no external information and guidance will be received regarding its movements and position in the field. In the event that any external information and guidance is understood, the competing team may be excluded from the competition with the decision of the referee.
- Competition teams will be headed by referees who will ensure communication and transfer the information to be obtained from the field. The competition teams will use the control stations to transmit the measurements and/or readings they take from the field to the table referees. The desk referees will record the relevant places on the pre-prepared competition score sheets for each team.
- The competitor team has 10 minutes of preparation time after being called to the competition track. Within this period, the competition will start as soon as the land robot is placed on the field. At the end of 10 minutes, the competition will start regardless of

whether the land robot is placed on the field.

- If a situation requiring maintenance or change occurs after the start of the competition period, the vehicle may be taken out of the area upon the request of the team leader. In this case, the time is stopped and 10 minutes additional maintenance time is given for once. If the support of other team members is needed, the relevant team members can come to the area where the vehicle is located. At the end of the 10 minute period, the competition time continues to run in any case.
- In cases requiring changes on the vehicle during the competition outside the maintenance period (cable entanglement, etc.), soil blocking the wheel, etc., with the approval of the referee, the vehicle can be taken out of the field, changes / corrections can be made and the vehicle can be left back in the field. However, even if the vehicle is out of the field, the competition period will continue.
- For special cases that are not mentioned in these specifications but may arise during the competition, the Competition Committee will meet and decide on a case-by-case basis.

9.2. Referee Briefing

The referees will read the technical reports of the teams before the competition and will have information about the teams. While the teams are competing, one referee will work at the control desk and one referee will work at the course area.

The competing teams will communicate their work for the tasks they perform during the competition to the referees. After the robot enters the track, the referee at the beginning of the track will check the external interventions that will affect the movement of the robot (such as steering the vehicle with a cable) and will stop the competition in case of any negativity. Referees will be responsible for the application of the rules during the competition. In case of any safety concerns or problems that may arise during the competition, the referees are authorised to stop the competition and cut the power to the land vehicle.

This authorisation is given both for safety and for the protection of the electronic components of the competitor team's vehicle on the track. After the competition stages, the referee committee will evaluate the final evaluation report of the teams by interviewing each team. The competitor team producing the land robot is expected to be able to answer technical questions about the vehicle. advisor will not be able to participate in the interview.

10. SCORING, EVALUATION AND COMPETITION TRACKS

Scoring and evaluation will be carried out under two headings. Scoring for both sections will be as detailed below. The sum of the points from the four sections will determine the final score of the team at the end of the competition.

10.1. Report Scoring

STAGE	SCORING PERCENTAGE
Critical Design Report (CDR)	%15
Movement and Capability Demonstration Video - Presentation Phase	%15
Final Evaluation	%70

Table 2 - Evaluation Percentages of Competition Stages

10.2. Track Details

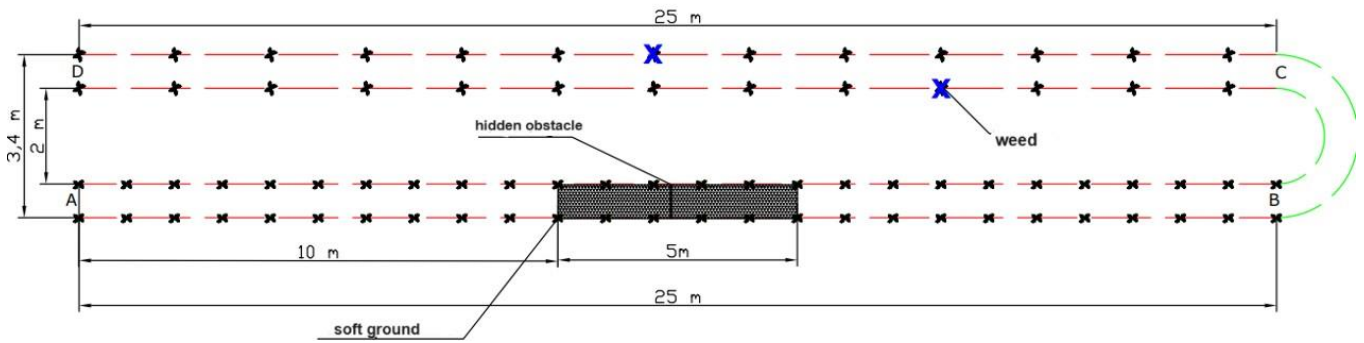


Figure 2 - Track Details

Scenario;

1. The Agricultural Unmanned Ground Vehicle (UGV) must be brought to the race start line. The start line will be positioned at a 30° angle to the plant row.
2. Agricultural UGV should be activated and enter the queue autonomously from point A.
3. The soil cultivator element on the vehicle entering between the rows in full length should be sunk into the soil to a depth of 5 cm from the soil surface and the hoeing process should be carried out. (The sinking process can be done while the advancing movement continues).
4. TIKKA must pass autonomously by hoeing the soil between the plant rows between points A and B (without the processor element leaving the soil) without crushing the plants in the row. On the A-B track (between the rows), there is a soft soil ground (sand pool) starting from the 10th meter and continuing until the 15th meter. There is an obstacle placed perpendicular to the direction of movement in the soft ground. Since this obstacle is underground, it cannot be seen from the outside. Additionally, the obstacle will be positioned differently in the direction of movement for each team. When TIKKA's soil processor element encounters this obstacle while the vehicle is moving, the processing arm must be taken out of the soil autonomously, and after the obstacle is passed, it must return to its first position in the soil autonomously. Coming out of the soft ground, TIKKA must process another 10 meters of soil within the specified constraints and reach point B. Arriving at point B, the Agricultural UGV must be autonomously dispatched to point C and positioned as desired by the team in order to enter the queue on the C-D track.
5. Agricultural UGV C-D course (between the rows) must till the soil within the specified limits for 25 metres, while at the same time identifying and recording the position of the weeds on the row, one in the right and one in the left row. The position of weeds on the row will be different for each team.
6. Agricultural UGV should stop autonomously after the vehicle has travelled the full length of the C-D track and bring the tillage unit to the soil surface.

Final Evaluation Criteria	Score
A-B Autonomous entry into the queue	10 Points
A-B Autonomous tillage between the rows with a tillage unit at a depth of 5 cm	25 Points
A-B Autonomously cross the soft (sand) soil barrier between the rows and start tillage	15 Points
Autonomous stopping with full vehicle length between rows A-B	5 Points
C-D Autonomous entry between the queue	10 Points
C-D Autonomous tillage between the rows with a tillage unit at a depth of 5 cm	15 Points
C-D Seeing weeds on the right and left row between the rows and recording their positions	15 Points
Autonomous stopping with full vehicle length between rows C-D	5 Points

Table 3 - Final Evaluation Criteria

*** Agricultural UGV needs to autonomously fulfil its tasks on the track.*

10.5. Awards and Rules

As a result of the separate evaluation in four stages of the competition, the teams that pass the report stages and reach the final in their category and rank in the final evaluation will be awarded a cash prize. The awards stated in the table below show the total amount to be given to the teams that are entitled to receive awards, individual awards will not be made. The first, second and third prizes will be divided equally according to the total number of team members (all members registered in the system) and will be deposited into the bank account specified by each individual.

Within the scope of the competition, the advisor of the winning team will be paid. Payment will be made to the advisor of the team that ranks within the scope of the competition. 4.000 ₺ will be paid to the advisors of our ranked teams. If the advisor does not come to the competition area, the advisor award will not be given.

The following prizes will be awarded at the end of the competition;

Degree	Award Amount	Counsellor
First	100.000 ₺	4.000 ₺
Second	80.000 ₺	4.000 ₺
Third	60.000 ₺	4.000 ₺

Table 4 - Awards

Most Original Design Award

- With the report stages, the Competition Evaluation Board makes design evaluations.
- The Competition Evaluation Board will determine the teams with the best design by

voting method by considering the criteria of conformity to the design conditions, originality and evaluation according to the scope of the competition and agricultural IKA and all subsystems. The specified award is for prestige purposes and does not have a financial equivalent.

10.6. Minimum Achievement Criteria for Award Ranking

In order for a team to be deemed successful and receive an award, the competing team must fulfil all the conditions stated below;

- Carry out cultivation in accordance with the rules (hoeing) and detect weeds.
- Completing the track.

They must physically intervene by exiting autonomous driving at most twice. Teams that fulfil their tasks will be considered successful. When ranking the teams that fulfil all the tasks, firstly the score is taken into consideration. If the points are equal, the time to complete the track is taken into consideration. The first three teams that do not fulfil the specified conditions but qualify for the ranking will be awarded honourable mentions to be determined by the Agricultural IKA Competition Advisory Board.

When ranking the teams for the honourable mention award, if the points are equal, the time to complete the course is taken into consideration.

10.7. Evaluation

The following rules are applied to determine the winning team;

- Agricultural UGVs are scored separately for the tasks assigned.
- Agricultural UGV wins the competition with the highest score as a result of report evaluation scores and final evaluation.
- In case of score equality, the Agricultural UGV that completes the task in the shortest time wins the competition.
- If the tie is not broken, these teams are given one more competition with the same rules.
- If there is no equality under the above conditions, the Advisory Board and the Referee Committee will distribute the prizes.

11. COMPETITION AND VEHICLE DETAILS

- The competition track will be in a real field or an area simulated as agricultural land.
- Agricultural UGV, which will be designed within the scope of the competition, must have an energy system that can move smoothly in the agricultural field and have enough energy to complete the track.
- It will have a communication system that can communicate with the interface system in the field of agricultural land.
- Tika participating in the competition must be a Tika that can cultivate the soil and detect weeds in agriculture. For example, IKA, who went on a mission on the track, examined the plant rows in the area.
- It should be able to pass autonomously by processing the soil between the rows at a depth of 5 cm without crushing the plants in the row (without the processing element leaving the soil) and detect the weeds from their characteristics (height, color,

appearance, etc.). The method of cultivating the soil by IKAs must be an agricultural solution (hoeing), and the contestants will receive points as they cultivate the soil correctly (per meter) and detect weeds along the path within the given time. In addition to its compliance with the technical criteria specified in this specification, the Agricultural UGV to be developed must be applicable in the agricultural field, be beneficial for farmers and be economically viable.

- The competition area will be in the form of a ploughed and subsequently sown field, with patches of soil, small stones, small rises and falls created during the ploughing and sowing of the field.
- **A maximum of 2 people** from the teams will be taken into the competition area.
- Objects that are weeds in the competition will be used as portable.
- The maximum duration of the competition will be **50 minutes**.
- In the soft ground (sandbox) there is an obstacle placed perpendicular to the direction of movement. The obstacle is expected to be passed autonomously without manual intervention. The obstacle will not be visible from the outside as it is under the soft ground. The obstacle will be positioned differently for each team in the direction of movement. When Agricultural UGV encounters this obstacle while moving, the processing arm should be moved out of the soil autonomously, and after the obstacle is passed, it should return to its initial position in the soil autonomously. Obstacle dimensions will be shared with the teams in the future.
- Sequential sowing will be done between the rows in the track and weeds will be placed randomly on this row. The locations of the obstacles and weeds on the area shown in the picture will be positioned in different places for each team in the real competition area.
- Detailed information about the weed that is expected to be recognized and detected in the field by TIKa will be shared with the teams in the future. Details of the track area (soil type, sand type, number of rows, area information, etc.) will be explained in detail later.
- Each team must provide its own internet needs in the competition area.
- The sample field sketch is as follows.

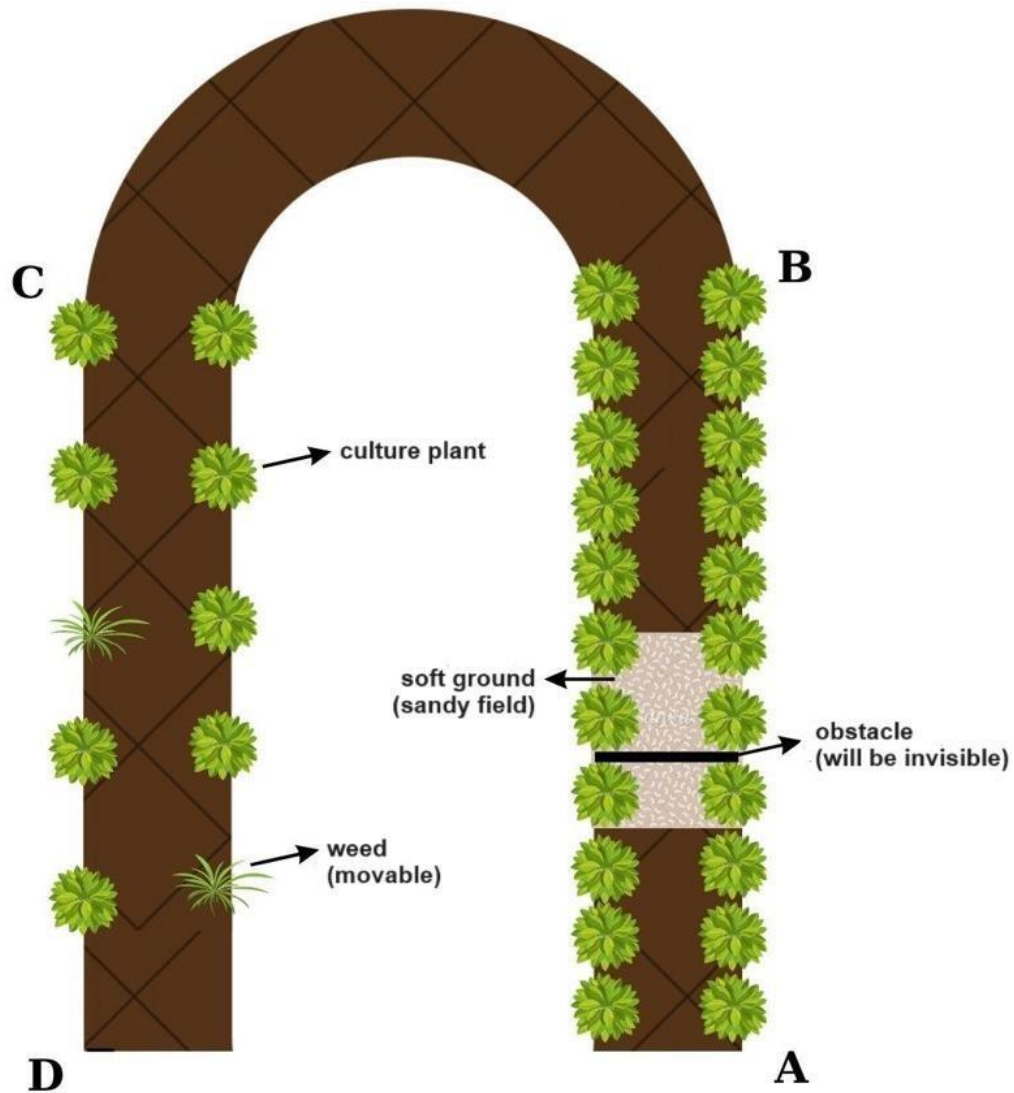


Figure 3 - Sample Parkour Visualisation

12. GENERAL RULES

[Click here](#) to access the general rules document for the competition.

13. CODE OF ETHICS

[Click here](#) to access the code of ethics document for the competition.

DECLARATION OF RESPONSIBILITY

T3 Foundation and TEKNOFEST are in no way responsible for any product delivered by the competitors or for any injury or damage caused by the competitor. T3 Foundation and the organisation authorities are not responsible for any damages caused by the competitors to third parties. T3 Foundation and TEKNOFEST are not responsible for ensuring that the teams prepare and implement their systems within the framework of the laws of the Republic of Turkey. Technology Team Foundation of Turkey reserves the right to make any changes in this specification.

