DIRECTORATE GENERAL OF VOCATIONAL AND TECNICAL EDUCATION

18th INTERNATIONAL MEB ROBOT COMPETITION

MINI SUMO

CATEGORY GUIDE

TÜBİTAK | TİKA

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CONTENTS

MINI SUMO CATEGORY COMPETITION RULES

1. GENERAL INFORMATION ABOUT THE COMPETITION

1.1. Objective

The Mini Sumo Competition aims to encourage students to design sumo robots that can operate completely autonomously by combining electronic, mechanical design and software components, and to have these robots compete on a standard dohyo. The competition aims to support the development of robotic applications based on autonomous perception, decision-making and motion control, while also promoting the dissemination of R&D processes involving strategy generation, rapid response to sensor data and safe design principles at secondary school and university level. In this process, students are expected to access the necessary technical knowledge, transfer the knowledge they have acquired to robot design, analyse performance issues that arise during interaction with rival robots and develop solutions, and create original design and software strategies by experimenting with different sensor/algorithm approaches.

1.2. Theme

In this competition**,** students will have the opportunity to showcase their robotics and artificial intelligence-based engineering skills by designing fully autonomous mini sumo robots. During matches held on a dohyo of standard dimensions, the robots' abilities to perceive, make decisions, and react quickly will be tested as they aim to push their opponents off the track. The effective use of real-time sensor data, mechanical durability, the performance of control algorithms, and strategic movement planning form the core themes of this competition. The aim is for students to develop competitive yet safe robot designs, gain practical experience in the working principles of autonomous systems, and develop their problem-solving skills in a real competition environment.

1.3. Participation Requirements and Team Structure

High school and university students may participate in the Mini Sumo category in accordance with the principles outlined in the Application Guide. Each team may apply for the competition with one (1) operator and one (1) assistant student per robot.

Only one operator per robot may enter the competition area. The operator is responsible for placing the robot on the dohyo and conducting the competition process in accordance with the referee's instructions. All participants in the competition area must comply with safety rules and referee instructions.

1.4. The Critical Importance of Reading the Guidelines

The International MEB Robot Competition is a comprehensive organisation that brings together technical knowledge, engineering skills and creativity. **The Mini Sumo category** expects competing teams to design robots that can move completely autonomously on a dohyo in accordance with the specified rules.

Success in this competition depends not only on the mechanical power or software complexity of the robot, but also on the correct reading and complete implementation of the rules set out **in the Application Guide** and **Category Guide**. These guides bindingly define all technical and competition rules specific to Mini Sumo, such as the robot's dimensions, weight, systems used, scoring principles, and violation situations.

As rules and applications may be updated during the competition process, competitors must regularly follow the announcements published **on the official website of the International MEB Robot Competition**. Failure to comply with the rules specified in the guides may result in **a warning, loss of points or disqualification**, regardless of the robot's performance.

Therefore, all teams applying **for the Mini Sumo category of the 18th International MEB Robot Competition** must carefully review **the Application Guide**, accessible from the "Organisation" menu at https://robot.meb.gov.tr, throughout the competition process.

2. TECHNICAL SPECIFICATIONS AND RESTRICTIONS OF THE ROBOT

2.1. Dimension and Weight Restrictions

a. Robots competing in the Mini Sumo category must fit entirely within a **10 cm × 10 cm** volume during technical checks prior to the competition and at the start of the match. There is no height restriction for robots.

b. The total weight of the robot must **not exceed 500 grams** at the start of the match. No changes exceeding the specified limits in the robot's dimensions and weight are permitted during the competition.

c. Robots that do not comply with the specified size and weight restrictions will not be accepted into the competition or will be disqualified if detected before or during the competition.

2.2. Permitted Materials and Components

a. Robots competing in the Mini Sumo category must use materials in their body structure, mechanical parts, electronic circuits, motors, and battery systems that do not compromise competition safety or damage the dohyo surface or opposing robots. The use of body materials, motors, sensors, microcontrollers, and batteries commonly used in general robotic applications is permitted.

b. **Mechanical parts** designed to push or steer the opposing robot may be used on the robot; however, these parts must **not be sharp**. **A paper test** is conducted prior to the competition to verify the safety of blades. Robots with blades that can cut paper or are determined to have cutting properties will not be accepted into the competition.

c. However, the use of systems such as flashers, lasers, etc. (except standard IR sensors) that may adversely affect the opponent robot's sensors or operation, hard or abrasive materials that may cause permanent damage to the dohyo surface, attack mechanisms containing liquids, gases or dust, flammable materials and any type of projectile mechanism is prohibited. Furthermore, the use of vacuum, adhesive, EDF, or similar systems that prevent the robot from moving by adhering to the dohyo surface is also not permitted.

d. Batteries used must be securely placed so as not to cause damage to the robot itself, the opposing robot, or the competition area. Robots found to be using materials or components that violate the specified rules may be disqualified before or during the competition.

2.3. Software and Control Requirements

a. Robots competing in the Mini Sumo category must operate **completely** autonomously. The movements of the robots are performed by software loaded onto the robot before the competition begins; remote control, wireless control, or any external intervention of the robots during the match is not permitted.

b. Robots are started simultaneously by **the referee's command** at the start of the match. After the start signal is given, robots must **move within the first 10 seconds**. Robots that do not move within the specified time are evaluated according to the rules.

c. The end of the round is announced by the referee, and the robots are stopped by the referee's command. If a robot cannot be stopped by the referee's command, the competitor may intervene with **the referee's permission**. It is prohibited to design the software and control systems used in such a way that they will affect the sensors of rival robots or the competition area.

d. Robots that do not comply with these requirements may be disqualified from the competition if detected before or during the competition.

2.4. Detailed Description of the Robot

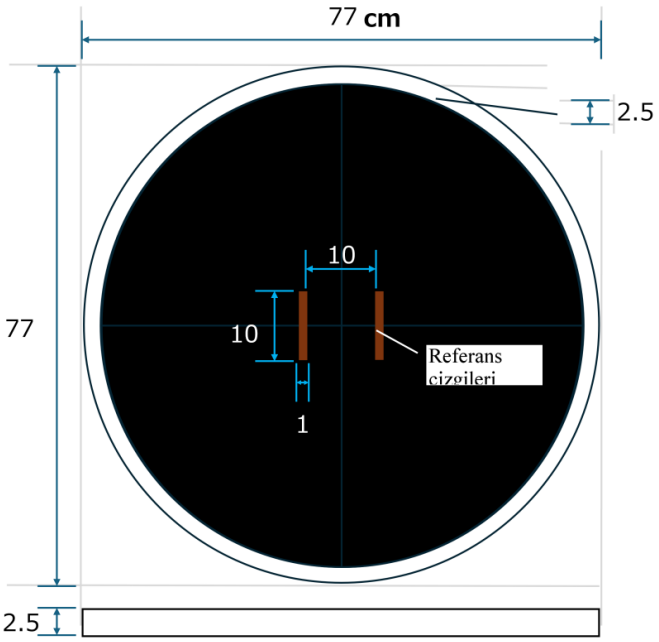
Robots must not contain any mechanism that **anchors itself** to the dohyo surface, thereby increasing its mobility or obstructing the movement of an opposing robot. Designs that create physical locking with the dohyo using vacuum, adhesive, magnet, suction surfaces, or similar methods are not permitted.

Robots competing in the Mini Sumo category may feature certain category-specific mechanical additions. In this context, **the use of the Mini Sumo Robot Flag Mechanism (Matador)**, as described at , **which is a double-wing flag mechanism** that can be easily attached to the robot, **is permitted provided that the size requirements are met**.

3. COMPETITION AREA AND TASKS

3.1. Shape and Dimensions of the Competition Area/Track

a. Mini Sumo category matches are held on a circular competition area called a dohyo. The dohyo is a circular track made of MDF material, 77 cm in diameter, with a flat and smooth surface. The track surface is designed to have contrast features that can be detected by the robots' sensors.



b. Around the dohyo, there is a 2.5 cm wide white dividing line to mark the boundaries of the track. This white area is considered within the dohyo boundaries. On either side of the centre of the dohyo, 5 cm away from the centre, there are corresponding reference (brown) lines, 1 cm wide and 10 cm long, to serve as a reference for the starting position.

c. The dimensions of the dohyo and the positions of the reference lines are shown in the technical drawings and in the guide. Only dohyos that comply with these standards will be used during the competition, and the referees will decide whether dohyos with damaged or dirty surfaces may be used.

3.2. Description of Task Objects and Components

a. The competition area used in the Mini Sumo category has a simple and standardised structure in terms of task objects. On the dohyo, **the white separation line** and **starting reference lines,** which robots can use as references in their detection and positioning processes, form the basic task components.

b. **The 2.5 cm wide white separation line** around the dohyo defines the track boundary and is designed to be detectable by robots. This line is part of the dohyo area, and contact by a robot outside this line is one of the fundamental factors affecting the outcome of the relevant round.

c. **The (brown) reference lines** used for the robots' starting positioning are located on either side of the centre of the dohyo and ensure that the robots are placed in the correct position before the match. Apart from this, there are no walls, obstacles, target boards or moving task objects on the dohyo.

d. All task objects and components are kept fixed at standard dimensions and characteristics throughout the competition. Any changes to these components are not possible without the approval of the referees.

3.3. Object Placement Procedure and Tolerance

a. **The white separation line** and **starting reference lines** used as task objects in the Mini Sumo category are located in predetermined fixed positions on the dohyo. These components are placed by the organisation in accordance with standard measurements prior to the competition and their positions are not changed during the competition.

b. The reference lines used as the starting position for the robots are positioned symmetrically relative to the centre of the dohyo. Before the match begins, the robots are placed in line with these reference lines and parallel to them, as directed by the referee. At least one point of the robot must be in contact with the area in line with the reference line.

3.4. Task Description and Application Conditions

a. To commence the match, competitors must place their robots **in working order** on the dohyo, **aligned with the starting reference line**, under the referee's direction.

b. Competitors are obliged to place their robots on the dohyo **within the specified time** after the referee's signal. The referee's decision applies to robots not placed within the specified time.

c. Robots are expected **to start automatically** upon the referee's start signal and continue the match entirely **under their own control algorithms**.

d. Robots that **do not move within 10 seconds** after the start signal are considered to have failed the task, and the relevant rules are applied.

e. During the match, robots must compete within the boundaries of the dohyo. If a robot leaves the dohyo or makes contact with it, the round result will be evaluated according to the relevant rules.
f. Contact and collisions between robots during matches are natural. The authority to evaluate and decide on these contacts **rests with the referees**.
g. **No breaks, maintenance, or repair time is granted** while an active round is in progress.
h. Robots **may not leave permanent marks** on the dohyo surface, cause damage, or engage in any activity that alters the surface properties during the match.
i. Only **battery-powered energy sources** may be used in robots. **The use of liquid, gas, or flammable energy sources is prohibited**.
j. Objections based on lighting, cameras, screens, and similar environmental factors in the competition environment **shall be deemed invalid**.

4. COMPETITION FORMAT AND EVALUATION CRITERIA

4.1. Application and Reporting Process

Applications for the Mini Sumo category are accepted through the International MEB Robot Competition general application system. In this category, **a Robot Production/Design Report** or **production video** is not required during the application process. The evaluation of competing teams is based on the matches and performance in the competition area.

4.2. Competition Stages

a. Starting position: Robots may be positioned in any direction along the reference line (brown line) and parallel to the reference line (shaded area). It is important for competitors to note that part of the robot must be in contact with the reference line and parallel to it. Examples are given in Figures 2.1 and 2.2.
b. It is prohibited to place the robot further forward (towards the centre) than the reference line or in a position where it does not make contact at all. The parallel direction of the robot is left to the user's discretion. Correct position examples are provided below.

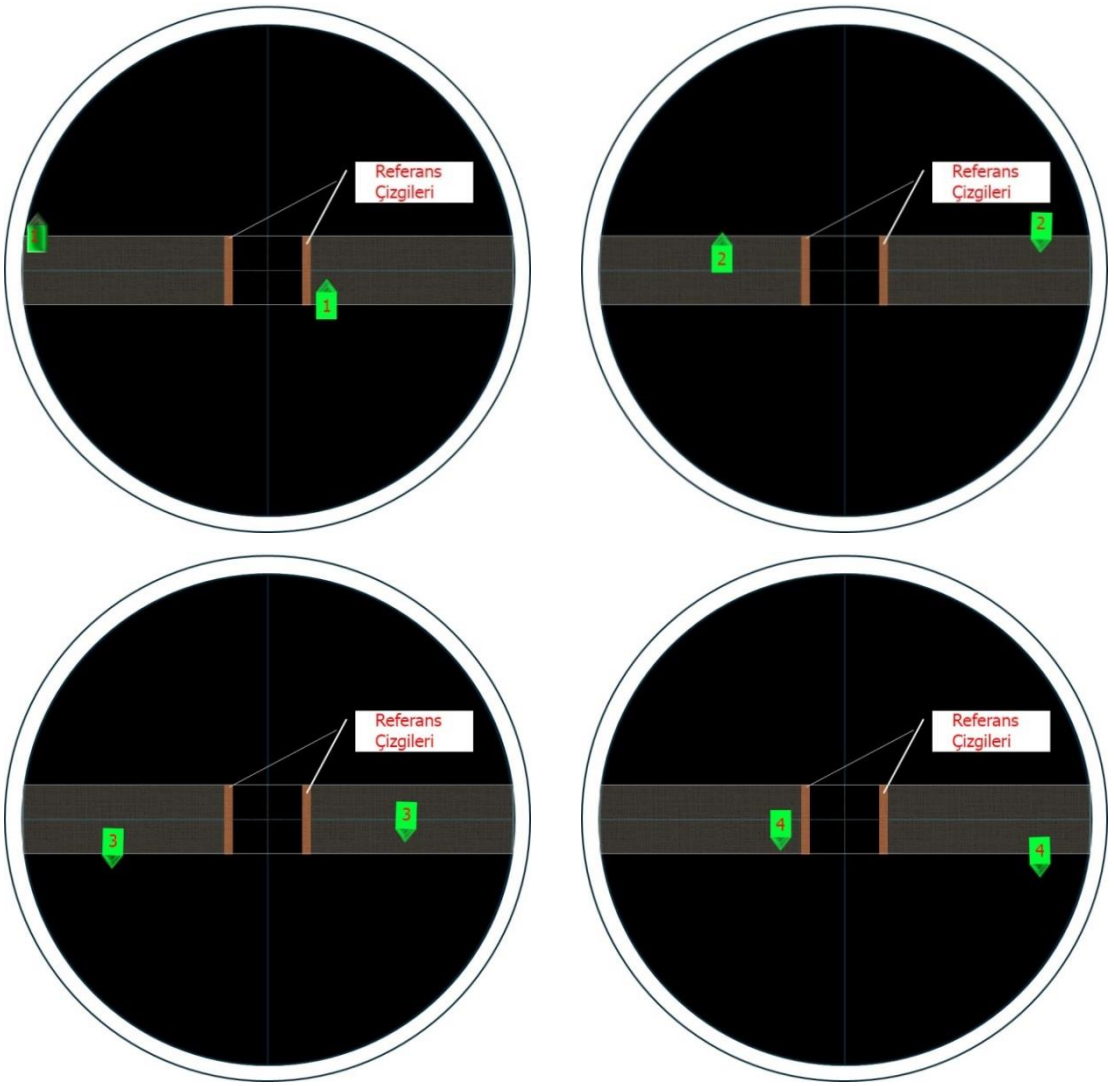


Figure 2.1: *Robot Placement on the Dohyo*

In Figure 2.2, the red positions indicate incorrectly placed positions.

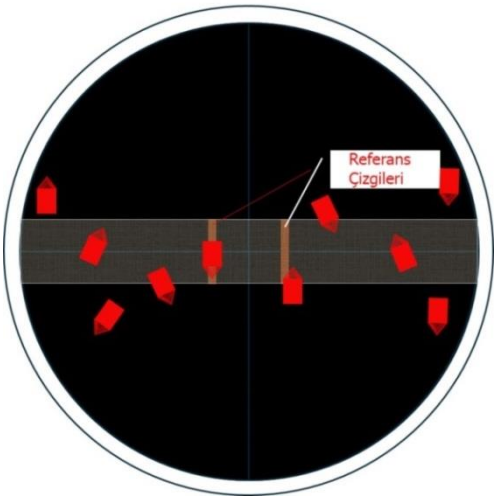


Figure 2.2: Incorrect placements

c. Sumo robots must be manually placed simultaneously according to the placement rules shown above before the match begins. Once placed on the dohyo, the robot's position cannot be altered.

4.3. Final Round

The competition rules remain the same in the final round. Only three teams advance to the final round, and if there is a tie in their matches, the effective point ranking is used as the basis for evaluation.

5. Scoring System and Evaluation

In the Mini Sumo category, the scoring and evaluation process is based on an effective points system conducted during the rounds played in the matches. Evaluation is based on the robots' behaviour during the round, their ability to gain superiority over the opposing robot, and their compliance with the rules defined in the guidelines.

5.1. Round and Match Principles

a. Each match is played over 3 rounds.
b. Each round lasts 3 minutes.
c. Winning a round is possible if any of the defined active point conditions are met.
d. The team that wins the round earns 1 effective point.
e. The team that reaches 2 effective points in a match is declared the winner of the match.

5.2. Effective Point Scoring Conditions

The winner of a round is determined if any of the following conditions are met:

a. The opposing robot making contact with or completely exiting the dohyo boundaries,
b. The opposing robot exiting the dohyo or touching the outer boundary as a result of its own movement,
c. The opposing robot remaining motionless for more than 10 seconds after the round has started (the opposing robot touching outside the dohyo does not change this situation),
d. The opposing robot losing a part within the rules,

e. Issuing two separate warnings/cautions to the opposing team within the same match.

When any of these situations occur, the round ends and the relevant team earns 1 active point.

5.3. Tiebreaker and Overtime Round

a. If both teams have an equal number of active points after three rounds, an overtime round is played.
b. The team that earns an effective point in the extra round is declared the winner of the match.
c. If neither team gains an advantage, the team with the lower robot weight is awarded 1 effective point to determine the winner.

5.4. Time and Point Relationship

There is no time-based bonus scoring system in this category. Round durations are defined solely to ensure the smooth progression of the game. Winning a round or the match depends not on time, but solely on the fulfilment of effective point conditions.

5.5. Referee Evaluation

- Referee decisions are paramount in the scoring and evaluation processes.
- Referees evaluate all situations arising during the match in accordance with the guidelines.
- Appeals against referee decisions may only be made within the procedures and timeframes specified in the guidelines; any other appeals shall be deemed invalid.

5.6. Race Duration and Use of Breaks

a. Matches in the Mini Sumo category are conducted within specified time limits to ensure the competition is run in an orderly and controlled manner. Each match is played over three rounds, with each round lasting three minutes. Round durations are defined solely to regulate the flow of the game; winning a round or match is not dependent on time. Judging is based solely on the fulfilment of active scoring conditions, even if the time has expired.
b. No breaks, maintenance, or technical interventions are permitted on the robots

during the active round time. It is prohibited to intervene with the robots or remove them from the dohyo before the referee announces the end of the round. At the end of the round, competitors may only remove their robots from the dohyo after the referee's announcement and using the designated areas. Robots that cannot be stopped by the referee's control may only be intervened with by the user with the referee's permission.

c. Between rounds, limited technical intervention is permitted, provided it does not interfere with the continuation of the match. This intervention is limited to the following conditions: it must be under referee supervision, the robot must not leave the track, no parts or materials may be taken from outside the track, no changes exceeding the robot's weight limit may be made, and it must not exceed thirty seconds. Interventions carried out outside these conditions are considered rule violations.

d. In the event of injury to a competitor during the competition or if the match cannot continue safely, the competitor may request that the match be stopped. In this case, the referees shall make the necessary arrangements for the game to continue. If the arrangements made do not allow the match to be restarted, the opposing team shall be declared the winner without a match being played.

6. ETHICAL AND OTHER RULES

7.1. Disqualification and Penalty Situations

a. In the Mini Sumo category, in order to ensure that the competition is conducted fairly, safely and in accordance with the principles of sportsmanship, behaviour that violates the rules may result in a warning, loss of points or disqualification. Rule violations detected by the referees during the matches are evaluated according to the nature of the violation and the relevant sanctions are applied. The referees' decisions are final in these evaluations.

b. Situations such as a competitor changing the position of their robot after it has been placed on the dohyo, or engaging in behaviour deemed fraudulent or unfair by the referees, are subject to **warnings**. If the same competitor receives two warnings in the same match, **1 effective point** is awarded to the opposing team. Warnings do

not constitute grounds for immediate disqualification from but are applied as sanctions that affect the outcome of the match.

c. Under the rules, **violations** occur in cases where a part falls off a robot, the robot remains motionless for more than ten seconds after the start signal, or the competitor requests that the match be terminated. In such cases, **1 effective point** is awarded to the opposing team. These types of violations are considered technical rule violations that affect the course of the match.

d. In the event of the following situations, the competitor is deemed **to have lost** the relevant match **directly** and is disqualified:

   If the competitor fails to arrive at the designated dohyo within five minutes after their match time, deliberately sabotages the match or intentionally damages the dohyo, the robot fails to meet the autonomous operation requirements, a fire occurs in the robot and this prevents the continuation of the competition, or the competitor exhibits unsportsmanlike behaviour.

   Verbal or physical interventions directed at opponents, referees, or event staff are also subject to disqualification.

e. Furthermore, if deemed necessary by the referees, intervention may be made in the match and the competitor may be disqualified if the robot acts contrary to safety measures, endangers the safety of the competitor or the competition area. In all penalty and disqualification applications, the order and safety of the competition shall be taken into account.

7.2. Appeal Procedure

a. Appeals regarding the competition process will only be considered in accordance with the procedures and principles specified in this procedure. Appeals must be made by the team advisor within the time period specified by the organising committee following the completion of the relevant competition stage or the announcement of the results. Applications made outside the specified time frame or by unauthorised persons shall be deemed invalid. Appeals must be submitted via the relevant heading on the www.robot.meb.gov.tr website, clearly and comprehensively stating the subject and grounds for the appeal.

b. Appeals alleging issues arising from illuminated screens, cameras, lighting systems, or similar environmental factors present around the track during the competition shall be deemed invalid. Similarly, appeals concerning issues alleged to have arisen from the control module used by the referee shall not be considered.
c. The organising committee shall conduct an investigation, consulting the jury, referees or technical officials as deemed necessary, and the decision taken shall be communicated to the relevant party. Decisions made by the organising committee are final and no further appeals may be lodged against them. All teams participating in the competition are deemed to have accepted this appeal procedure in advance by applying.
d. Decisions made by referees following their evaluation are final. If objections to referee decisions are pursued in a manner that disrupts the general flow of the competition or if unsportsmanlike conduct is exhibited, sanctions may be imposed in accordance with the relevant provisions.

7.3. Warnings and Ethical Rules for Competitors

Robots used in the competition must comply with the terms and conditions during the technical inspection phase. Mechanical and electronic components that may break, disintegrate, or pose a safety risk during the competition are not permitted on the robot. The use of structures and mechanisms that may damage the course, other robots, or competition equipment is prohibited.

It is important that participants carefully follow the calls and informational SMS messages sent during the competition. Announcements made via SMS will be considered valid notifications, and the participating team will be responsible for any problems arising from failure to follow these notifications. All information related to SMS (such as the phones to which SMS are sent and the time of dispatch) is stored in the competition management system. Please ensure that all phone numbers registered in the system for your team are correct.

One of the aims of our competition is to provide an environment where competitors can get to know each other over the years and share knowledge, experience and excitement.

Therefore, it would be in line with this aim for competitors called to the stands to find their opponents, get to know them and come together when called to the field.

To help our competitors feel at ease with the process, short videos explaining the pre-competition field checks and procedures have been made available to them. You can access these videos by copying the address " https://meb.ai/UP0F24K " into your address bar. A QR code has also been added to the end of the guide for this purpose.

Competitors are obliged to act in accordance with the principles of honesty, fairness and sportsmanship throughout the competition. Respectful behaviour towards the jury, referees, staff and other competitors is essential both in the competition area and throughout the entire organisation process. Cheating, unauthorised interference, receiving unauthorised assistance or any behaviour intended to influence the outcome of the competition will be considered an ethical violation.

Failure to comply with instructions given in the competition area, behaviour that disrupts the competition, or unethical conduct may result in necessary sanctions, including warnings or disqualification, by the organising committee. By participating in the competition, competitors are deemed to have accepted these warnings and ethical rules in advance.

7.4. Safety Measures

a. In order for the Mini Sumo category competitions to be conducted safely, competitors must comply with the specified safety rules. Protective goggles, gloves and sports shoes must be worn during the competitions, and it is the competitor's responsibility to provide this equipment. Competitors who do not use the necessary safety equipment will not be allowed to participate in the matches.
b. Robot designs and usage must not contain any elements that could cause harm to competitors or the competition area. Blades or similar parts on the robot must be blunted so that they cannot cut paper during the referee's inspection. Robots that fail the sharpness test will not be accepted into the competition.
c. To prevent situations that could cause fire or electrical hazards in robots, batteries must be equipped with overcurrent protection. If situations posing a safety risk are detected during the competition, the match may be stopped by the referee's

decision and the necessary measures will be taken.

d. Unauthorised interference with robots and behaviour that jeopardises safety is prohibited during the competition. Referees have the authority to take necessary measures in situations that pose a safety risk.

7.5. Authority of the Competition Organising Committee

The Competition Organising Committee is authorised to make all technical, administrative and organisational arrangements relating to the planning, execution and conclusion of the competition, to make any changes it deems necessary to the competition programme, and to make arrangements relating to the competition area and course. The Committee has the right to ensure the implementation of the competition rules, carry out technical checks, assign referees, make decisions regarding rule violations, and apply sanctions, including disqualification, when deemed necessary. All decisions taken by the Organisation Committee are binding and final, and all teams participating in the competition are deemed to have accepted these powers in advance.

7. CONTACT

8.1. Question and Announcement Tracking Channel

Questions, comments, and requests regarding the competition, as well as announcements made by the organisation, will be handled via www.robot.meb.gov.tr. Participants are obliged to regularly follow all information and announcements made during the competition process via this address. Applications, questions or announcements made outside the specified channels will not be considered valid, and the Organising Committee cannot be held responsible for any problems arising from failure to follow the announcements. All teams participating in the competition are deemed to have accepted this communication and announcement system in advance.

8.2. Competition Coordination Information

Information regarding the competition's "Organising Committee", "Executive Committee", and "Technical Advisor" can be found under the heading "ORGANISATION" at www.robot.meb.gov.tradresinde.

8. ATTACHMENTS

9.1. Competition Card

Separate competition cards for each round to be used in the competition

9.2. Sample Scenario

First Scenario:

In a match, two Mini Sumo robots compete over three rounds. In the first round, Robot A scored an active point by pushing its opponent out of the dohyo. In the second round, Robot B scored an active point by causing Robot A to touch the outside of the dohyo. In the third round, Robot A scored an effective point because Robot B remained motionless for more than 10 seconds. In this case, Robot A is declared the winner of the match with a total of 2 effective points.

Second Scenario:

After three rounds in a match, both robots earned one effective point each. Due to the tie, the match was taken to an overtime round. In the overtime round, Robot B succeeded in pushing its opponent out of the dohyo and earned an effective point. With this result, Robot B is declared the winner of the match.

Third Scenario:

After three rounds, neither robot scored an effective point, and no advantage was gained in the extra round either. In this case, according to the competition rules, the weights of the robots were compared; the lighter robot was awarded 1 effective point, determining the winner.

Fourth Scenario:

During one round, a part on Robot A fell off, which was considered a rule violation. The fallen part was found to weigh more than 10 grams, and according to the rules, an effective point was awarded to Robot B. This round ended with Robot B's superiority.

Recommendation: Some robots whose start-up module is not enclosed may naturally experience interference from front, rear, and side signals, causing the module to malfunction and preventing the robot from starting. To minimise such issues, the module's

surroundings can be elevated to ensure it only receives IR signals from above.An example is provided in Figure 3.

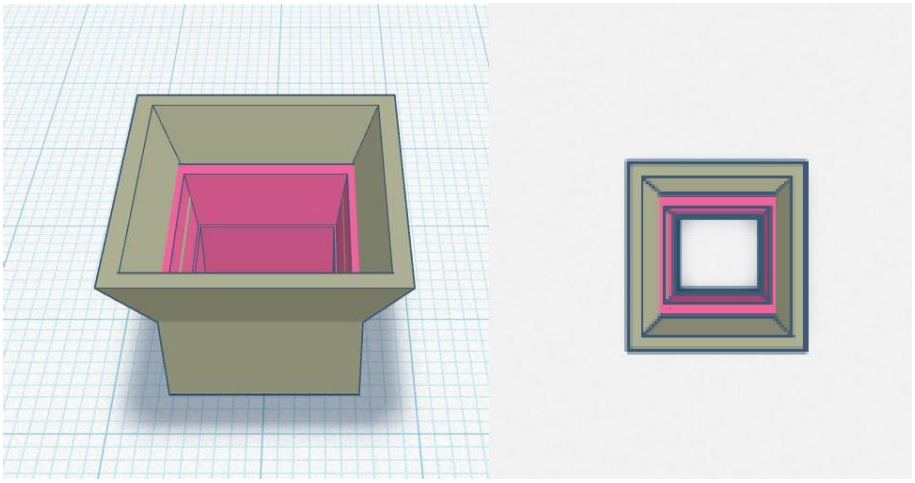


Figure 3: *Start module protection*

9.3. Start Module

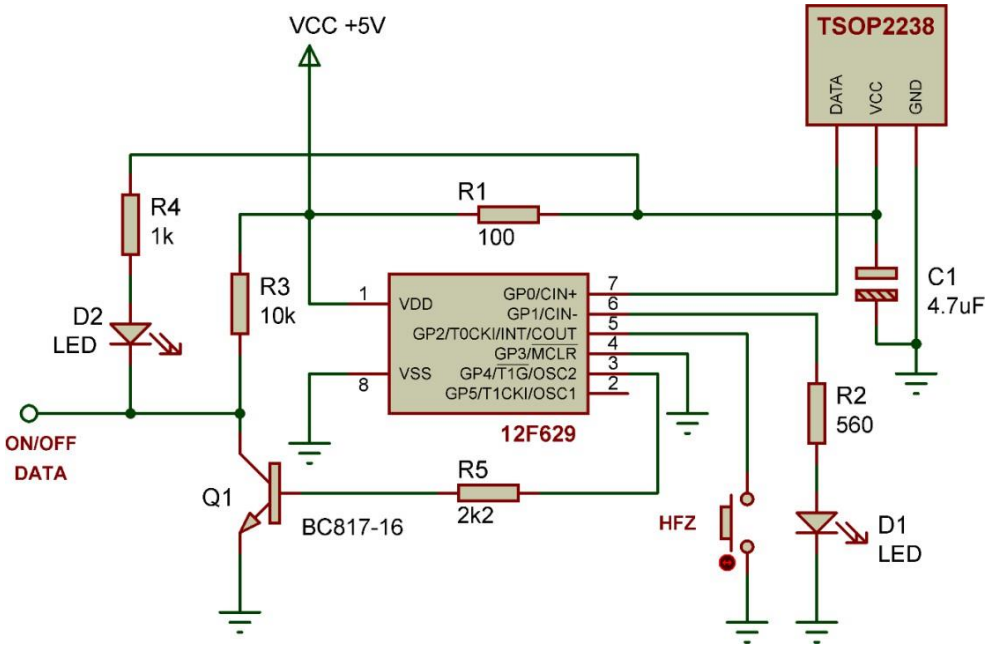


Figure 4: *Start module open circuit diagram*

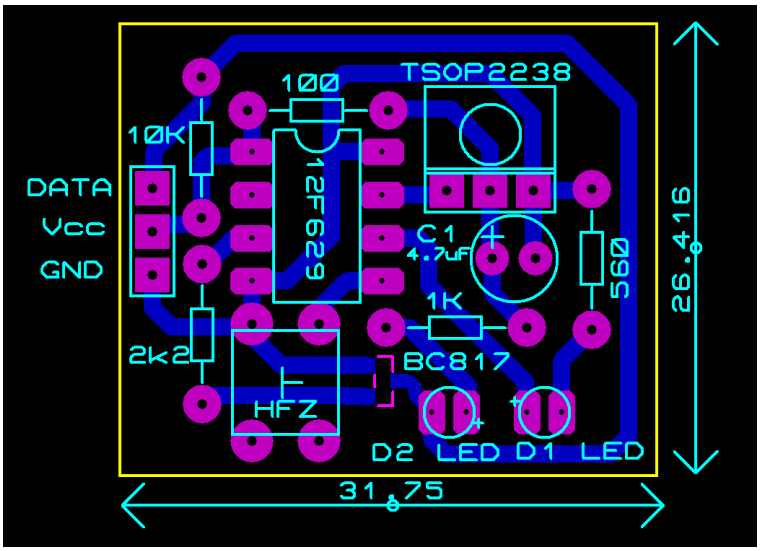


Figure 5: *Start Module Printed Circuit Board Diagram*

9.3.1. Operation of the Start Module

Once the required power supply voltage connection is made, it is first necessary to determine which button code the receiver will use for on-off operation. To do this, press the memory button on the circuit once, and the D1 LED will remain lit. In this state, press the button on the transmitter control that you wish to store in memory twice in succession and wait. The D1 LED will turn off. It is now ready for use.

To turn the output on, press the relevant button (the button stored in memory) on the remote once. The D1 LED flashes, and the D2 LED remains lit. The on-off output drops to 0 volts.

To turn the output off, press the relevant button (the stored button) on the transmitter once. The D1 LED will light up and then go out, and the D2 LED will go out. The on-off output will rise to +5 volts.

Any remote control using the "RC5" protocol can be used as the transmitter remote control for this circuit.

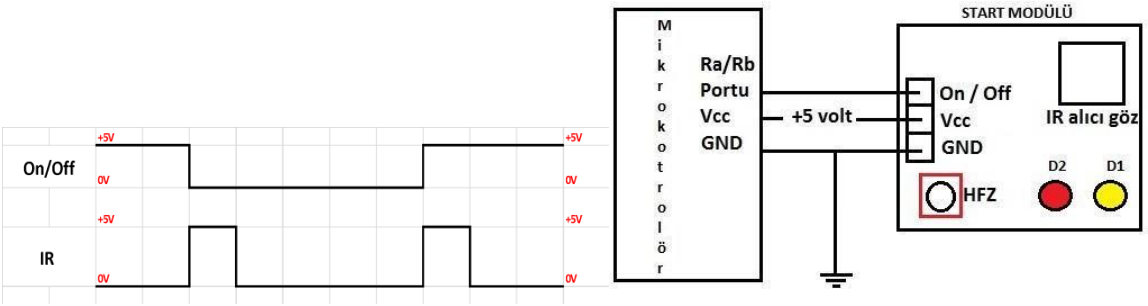


Figure 6. *Microcontroller connection of the start module*