



REPUBLIC OF TURKIYE  
MINISTRY OF NATIONAL EDUCATION  
The General Directorate  
of Technical and Vocational Education

# 16<sup>th</sup> INTERNATIONAL MoNE ROBOT CONTEST

## TOZKOPARAN (ARCHER) RULES

INTERNATIONAL  
MoNE  
ROBOT  
CONTEST



## RULES

### THEME

There were very strong archers ( means Kemankeş which is old Turkish word , keman=bow and keş=a person pulls something ) in Ottoman era. Sometimes when they would pull the bows so strongly that bow ends (means “toz” in Turkish) would be broken. Therefore these archers called as “Tozkoparan” which means a person who breaks tips of bow. Theme of this category was inspired by these strong archers called Tozkoparan.

This competition is carried on with robots that are built by using mechanic,software and sensor technologies. Competition frame consist of following a route , shooting a target and finishing the rouse as soon as possible. Robots will get scores according to successful levels and target scores.

### 1. OBJECTIVE

In this category, archer robots try to follow white lines on black colored platform and detech the colors, shoot to target board and return to finish gate in shortest time without mistake.

Tozkoparan Robot Competition will be held over 4 rounds according to point ranking. At the end of the 1st and 2nd rounds, there will be no elimination. At the end of the 3rd round, elimination will be made according to the 3 round total score ranking formed by adding the points received by the robots in all rounds and the robots that will pass to the next round will be determined. Depending on the number of robots participating in the competition, the number of rounds can be changed by the referees. At the end of each round, the total score ranking will be published. In order to advance to the 4th round, it is essential to be in the top 16 in the ranking. At the end of the 4th round, according to the point ranking to be made at the end of the 4th round, the first three ranked robots will win the competition as 1st, 2nd and 3rd respectively. Depending on the number of robots participating in the competition, the number of robots in the 2nd and 3rd rounds can be changed by technical advisors and referees

### 2. ROBOT

**Robots will move autonomously and shoot arrows. There is no limit for robot size. But its size (include shooting mechanism ) should be designed as pass through start/finish gates. Robots that can't pass the gates will be disqualified.**

### 3. ARROW

Arrow consists of 4 parts(figure 1). These parts are wooden body, arrowhead printed PLA in 3D printer, polythelen foam and velcro tape. Arrow body is made from circular shape wooden with 9mm diameter,180mm lenght. Arrowhead is printed PLA material with 28mm diameter, 14.75mm length, conic shape by 3D printer. Polythelen foam (28-20,5 mm diameter, 12mm thickness, conic shape) is sticked to make it flex.



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Velcro tape (36mm diameter female side) is stuck on this foam. To make easy sticking, tape is attached to the holes of PLA material on the arrowhead with rope. Weight of arrow is  $8 \pm 0,5$  gr and it is given by judge right before starting game and placed to shoot mechanism. Each robot will shoot it autonomously. When arrow sticks to target circles, it gets score. If it is not stick on target board and drops down, score will be determined by video camera.

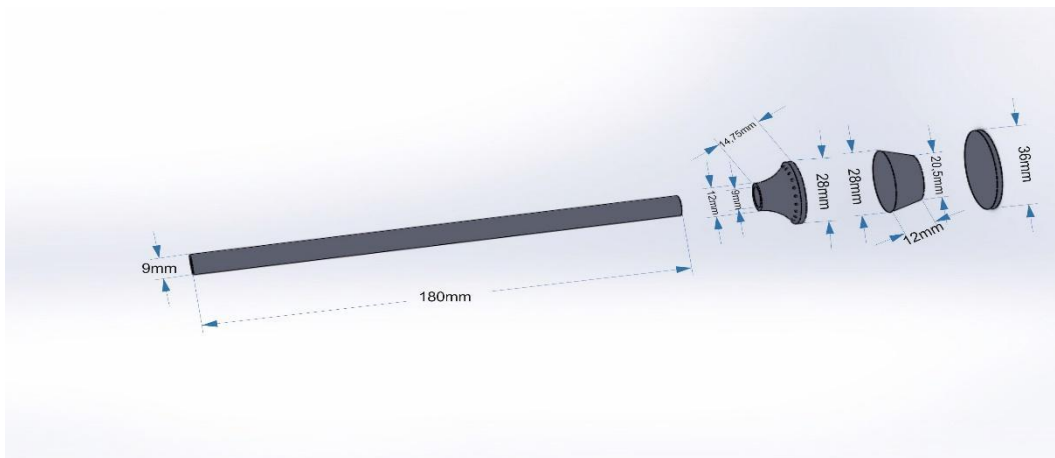


Figure-1 Arrow dimensions

#### 4. INFORMATION ABOUT SHOOTING MECHANISM :

Arrow dimensions are shown at figure-1. Competitors will design a shooting mechanism that able to throw such arrow from a certain distance and height to target board. Competitors can design it as they wish and they will assemble this mechanism on robot ( it should be sized as robot able to pass through start and finish gates.)

#### 5. TARGET BOARD

Target board (700x700mm) will be made by chipboard, its surface will be covered with polythene foam 12mm thickness to provide flexibility. Foam surface will be covered with velcro tapes (male side) . Target board will be placed 400mm high to facilitate shooting process and provide good view for spectators. To do this, it will has legs. Target surface is combination of 5 nested circles (biggest one has 600mm diameter) with different colors drawn on target board to able to scoring. Colors on the target board and their scores are shown below:

**Colours and scores :**



Score	Colour
100	Yellow
80	Red
60	Blue
40	Black
20	White

### Target board dimensions:

Target dimensions are calculated by using diameters of 5 circles which represent scores. Tolerances of each diameter is  $\pm 3\text{mm}$ .

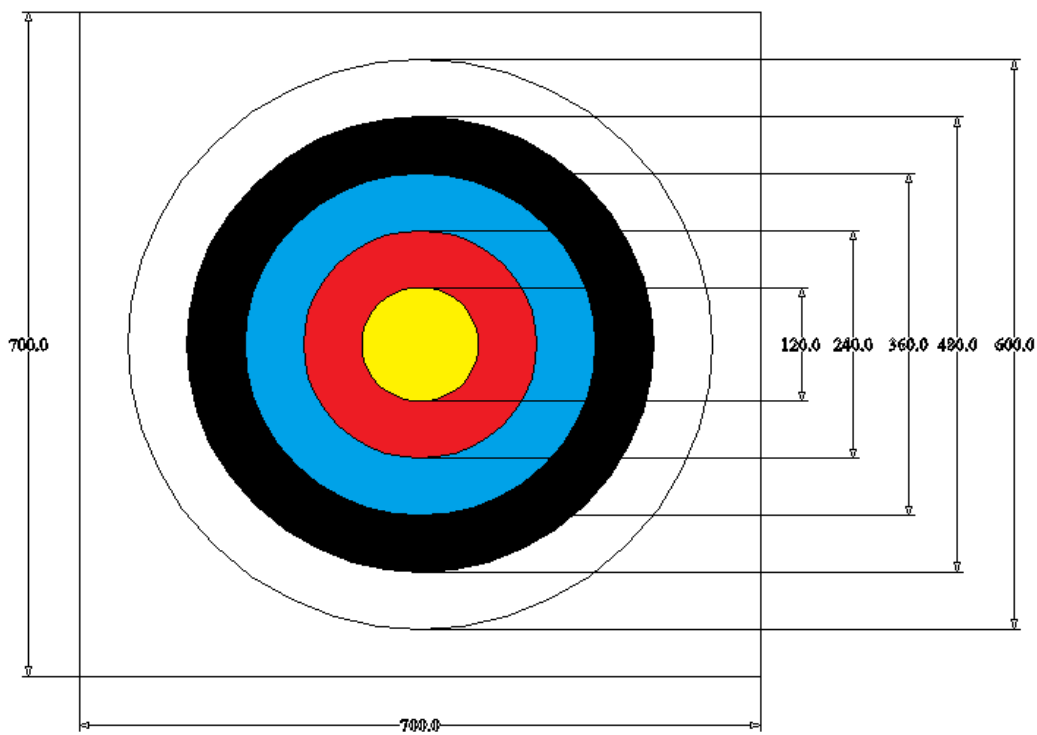


Figure 2- Target board and dimensions

## 6. RUNWAY

### Informations

- The roads on the platform are in the form of white lines on a matte black dactota background.
- The platform consists of two parts: 2900 mm x 3600 mm, 18 mm thick



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chipboard, 2900x3100 mm in size, made of 5 mm thick black matte dacota material and 1800x1000 mm, on which the 700x700 target board is located. For the race start area where the start gate is located and the race finish area where the sensors to end the competition are located, 2 pieces of 600x500 mm dacota material were also used. The joints of the parts forming the road were covered with black matte foil. A border of 18 mm thick and 68 mm high (the height on the competition floor will be 50 mm) was made on three sides of the chipboard used in the first part of the platform, except for the start and end sides. Together with the borders, the size of the first part is 2936x3618 mm. The total area covered by the platform is 5418x2936 mm.

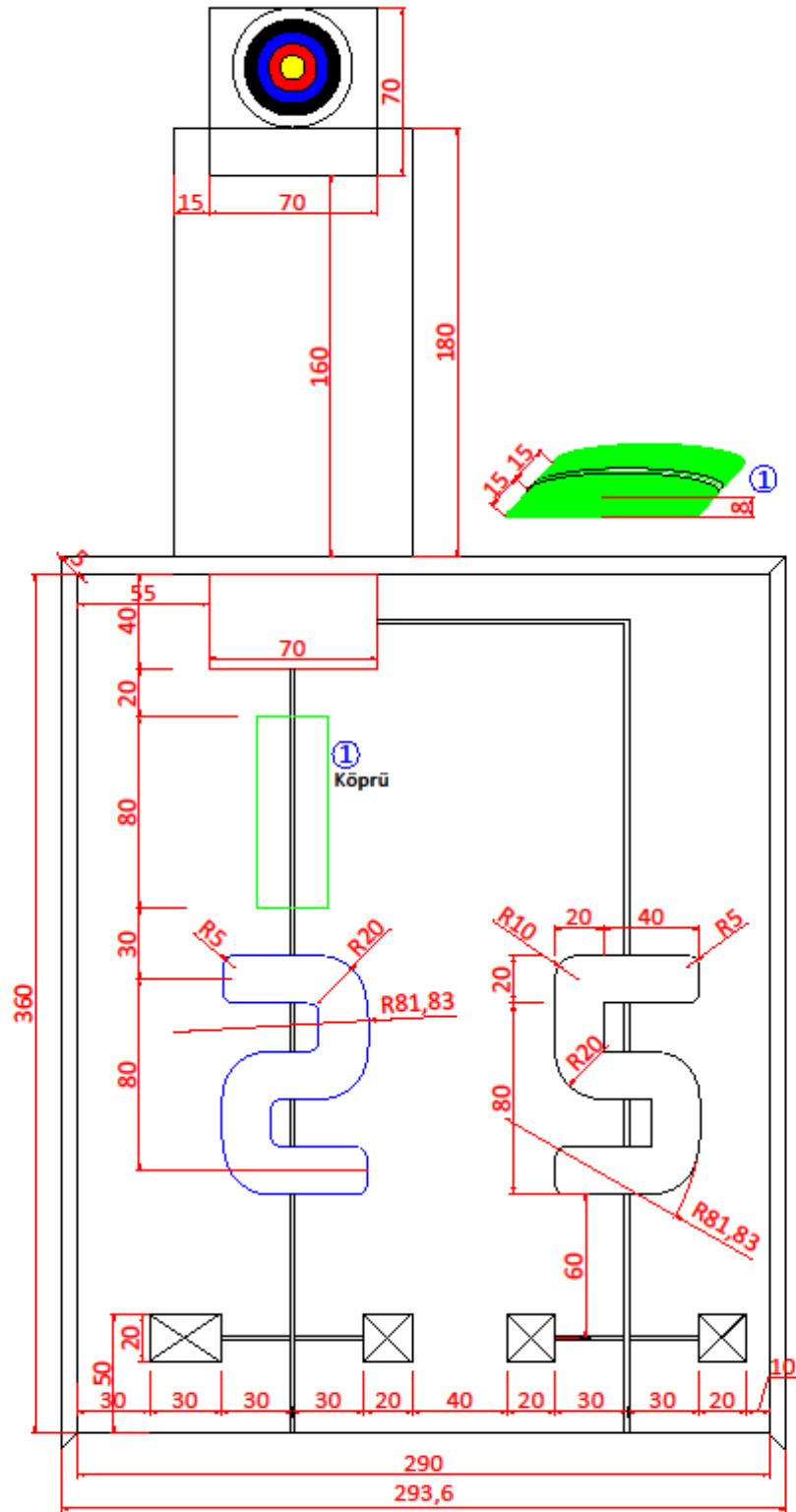
- The road lines on the platform are made of 20±2 mm thick white matte foil. The number 25 on the Dakota background consists of two different colors. Starting from the entrance, the region with the number 2 in the first row is blue, the region with the bridge in the second row is green, the region where the arrow will be shot is red, the region with the number 5 is white, and all of these colored regions are made of 2 mm thick matte foil. (Blue-Green-Red-White)
- When the robot detects the blue colored region (number 2) by following the white path line, the blue led will turn on and will continue to light until the green region (bridge). Then the robot will move to the green region and when it detects the green region, the blue led will turn off and the green led will turn on and the green led will continue to light until the red region. Then the robot will move to the red zone and when it detects the red zone, the green led will turn off and the red led will turn on and the red led will stay on until the end of the red zone. The robot will also stand inside the red colored zone and shoot an arrow at the target board. After shooting, it will turn and find the white return path. Then it will pass the white zone made of white foil (number 5) and follow the white path to reach the exit gate
- The dimensions of the colored regions; As in Figure-3, the dimensions of the blue region (number 2) and the white region (number 5) are 1000 mm x 600 mm. The dimensions of the green colored zone (Bridge) are length 800 mm width 300 mm maximum height 80 mm (the cross-sectional dimensions of the bridge are given by number 1 in the figure). The dimensions of the red zone are 700 mm x 400 mm.
- Two of the competition runways will be built and the runways will be prepared to be identical to each other. These runways will be named as runway A and runway B. The total area of the two runways is 7418\*7872 mm including the usage areas (1000 mm). **Figure-3**
- There is one start gate with white colour for each route. Gate will be opened by pressing start button and stopwatch runs for counting time. Height from its top is 250mm at opened position of gate and height from its bottom is 15mm at



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- Stopwatch will start counting when judges pressed start button and the gate opened. It will stop counting when robot arrives finish gate by sensor's detection. Finish sensor which is transceiver is placed between gate towers and 15mm high.
- Target board is located directly opposite of red zone. It is  $1918 \pm 5$ mm far from red zone . Bottom edge of target board is  $400 \pm 3$  high from ground.
- Judges will determined which route that robot will use will by using draw lot method.



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Figure 3 : Route dimensions



### Competition and Scoring

- Each robot competes in turn, this order is determined by lot. The draw determines which robot will compete on which track (track A or track B) Figure-4
- **The robot arriving at the referee's desk is sent to the competition area after the necessary controls and given an arrow for shooting. The competitor places the arrow on the mechanism on the robot and puts it in the starting area. The competition is started by the referee by giving the start. After the start of the competition, if the arrow falls out of the mechanism in any way or if the arrow is shot outside the shooting area, this will be considered as an error and the arrow can be put back into the mechanism by allowing manual intervention.**
- The robots will follow the line from the starting point on the track to the colored zone. It will detect the blue zone and the blue led will light up, then it will continue and recognize the green colored zone and the green led will light up, then it will detect the red zone and the red led will light up and it will stop in the red zone and shoot an arrow at the scored target board. After the shot, the robot will turn and follow the white line on the finish road and after passing the white zone, the competition will end when it reaches the finish gate by following the white line.
- The time will be kept with a stopwatch on the track. The stopwatch will start counting when the referee presses the start button to start the competition and the starting gate opens automatically, when the robot reaches the finish gate, the stopwatch will finish counting with the detection of the sensor and the competition will end.
- Each robot must finish the competition within 180 seconds. If the robot fails to finish the competition in this time, the stopwatch automatically stops counting and the competition is terminated. It is included in the ranking according to the points it has received until that moment.

### Scoring:

- Robots must move on the track in the specified direction of movement. From the start of the competition by the referee, **100 points** are given to the robots as base points. The robot will be evaluated with a total of **100 points** in the 7 stages it has passed in the time until it moves and reaches the finish gate. The score obtained as a result of arrow shooting will also be added to this score. Since the highest score on the target face is 100 points, the highest total score is **300 points**. Robots that do not come to the competition area and are disqualified are given **0 points**.
- If the robot makes a mistake on the track in any way, the competitor is given the right to intervene manually by the referee a total of 5 times until the end of the





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competition. After the 5th manual intervention, if the robot makes a 6th manual intervention or fails to perform its task for any other reason, the competition is terminated. The robots in this situation participate in the ranking according to the score they have received and the maximum finishing time of 180 seconds is accepted as the time they have finished.

- In the event that the robot makes a mistake in any way on the competition track, in case of manual intervention and in other non-hand intervention situations (such as the led not lighting up, shooting an arrow in the wrong place, not shooting an arrow in the red zone) **-5 points** are given as error points. In case of manual intervention, no matter how many times (maximum 5 times) at any stage, one error point is given.
- If the robot does not perform any of the 7 stages in the specified direction of movement in any way, reaches the finish point in a shortcut, the robot does not work in the start area, the arrow falls out of the mechanism and the arrow is shot outside the shooting area, the referee is allowed to intervene manually by the referee and continues from the stage and point where he made the mistake, if -5 points were not previously given as error points at that stage, -5 error points are given. Only in case of manual intervention in the red zone, the robot is allowed to continue the competition on the white line in front of the red zone without touching the red zone in order not to gain an advantage in arrow shooting

### Stages of the Competition:

#### Stage 1 - Start gate

After the start gate is opened, the robot that starts and crosses the start line is awarded **10 points**. Figure-4, the robot that does not work within 10 seconds or does not work and does not cross the start line is considered to have used the 1st hand intervention right. If the robot does not cross the start line in every 10 seconds after the 1st manual intervention, it is considered to have intervened manually, and in the case of the 6th manual intervention, that is, if the robot does not cross the start line in the 60th second, the competition is terminated by the referee and only **100 points** are awarded to the robot. In case of manual intervention, if the robot crosses the start line, one **-5 point** is given as an error point.

#### Stage 2 - White road line

If the robot follows the departure line and reaches the blue zone, **15 points** are awarded. No more points are awarded until the finish line. In case the robot leaves the white line in the specified direction of movement until the finish line and cannot find it again, the robot is put back on the track from where it left; in the meantime, the time continues to run. In case of manual intervention to the robot due to leaving the white road line during the movement on the track, one **-5 point** is given as an error point



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### Stage 3 - Blue zone

When the robot reaches the blue zone, **15 points** are given if the blue led lights up continuously until the green zone by detecting the blue zone and if it passes the blue zone and then follows the white line to the green zone border. If the blue led does not light up continuously until the green zone after reaching the blue zone, **-5 points** are given as error points.

In case the robot fails to reach the green zone limit, the robot is taken with the referee's signal and given the right to intervene manually and is put back on the track from where it came out. In case of manual intervention, -5 points are given once as error points. The -5 error point given due to leaving the white line is written as -5 points in the 2nd stage, if not written before.

### Stage 4 - Green zone

When the robot reaches the green zone, **15 points** are given if the green led lights up continuously until the red zone by detecting the green zone and if it passes the green zone and then follows the white line to the red zone border. If the green led does not light continuously until the red zone after reaching the green zone, **-5 points** are given as error points. In case the robot fails to reach the red zone limit, the robot is taken with the referee's signal and given the right to intervene manually and is put back on the track from where it came out. In case of manual intervention, -5 points are given once as error points. The **-5 error point** given due to leaving the white line is written as **-5 points** in the 2nd stage, if not written before.

### Stage 5 - Red zone

When the robot reaches the red zone, **15 points** are awarded if the red led lights up continuously until the end of the red zone and the robot stops in the red zone. If the red led does not light up after reaching the red zone, **-5 points** are given as error points, and in case the robot cannot stop in the red zone where the arrow will be shot at the target in any way, the robot is taken with the referee's signal and the right to intervene manually is given and the robot is placed on the white line before entering the red zone. In case of manual intervention, **-5 points** are given once as error points.

### Stage 6 -Arrow shot

If the robot shoots an arrow in the red zone and follows the white line to the border of the white zone (number 5), **15 points** are awarded. If the robot cannot shoot an arrow in any way, -5 points are given as error points. If the arrow falls out of the mechanism in the red zone or for any reason, it is not allowed to be put back into the mechanism. Only in cases that occur outside the Red zone, it is allowed to put the



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arrow back into the mechanism. In case the robot fails to reach the limit of the white zone (number 5), the robot is given the right to intervene manually by taking the robot with the referee's signal and it is put back on the track from where it came out. In case of manual intervention, one **-5 point** is given as an error point. The -5 error point given due to leaving the white line is written as **-5 points** in the 2nd stage if it is not written before.

### Stage 7 - White colored zone and finish

If the robot crosses the white zone (number 5) and crosses the finish line by following the white line, **15 points** are awarded. In the event that the robot leaves the white zone in the specified direction of movement, leaves the white line and cannot find the white line again, it is put back on the track from where it left, meanwhile the time continues to run. In case of manual intervention, -5 points are given once as error points. When the robot reaches the finish gate, the stopwatch stops counting with the detection of the sensor and the competition ends. The **-5 error** point given due to leaving the white line is written as -5 points in the 2nd stage, if it has not been written before.

### Scoring the Arrow Shot

An arrow will be shot autonomously by each robot. The shot is scored according to the position of the arrow tip on the target face. If the tip of the arrow touches two colors or any dividing line in two separate scoring zones, the arrow is scored as the higher of the two zones it touches. Apart from these, if the arrow hits the empty Velcro area on the target board outside the target surface and goes outside the target board, **0 points** are awarded.

### Colour Values

Score	Colour
100	Yellow
80	Red
60	Blue
40	Black
20	White



## The Code shaping the future of Track and Scoring Information to be used in Round 1, Round 2, Round 3 and Round 4 competitions:

- 2 tracks will be used for Round 1, Round 2 and Round 3 competitions (Track A and Track B) Figure-4
- In the 4th round, the track(s) used in the first three rounds will be used (track A and track B).
- As a result of the draw, it is determined which robot will compete on which track (track A or track B).
- Robots will compete individually in all rounds and ranking will be made according to the points they receive.
- In case of equality of points, the robot that finishes the track in a shorter time, and if there is equality again, the robot with less error points has priority over the other. In cases where the equality is not broken, the light robot has priority.
- There will be no elimination at the end of the 1st and 2nd rounds. At the end of the 3rd round, the scores of the robots in all rounds will be totaled and the robots that will pass to the next round will be eliminated according to the 3 round total score ranking. Depending on the number of robots participating in the competition, the number of rounds can be changed by the referees.
- At the end of each round, the total score ranking will be published.
- In order to advance to the 4th round, it is essential to be in the top 16 in the ranking. At the end of the 4th round, according to the point ranking to be made at the end of the 4th round, the first three ranked robots will win the competition as 1st, 2nd and 3rd respectively. Depending on the number of robots participating in the competition, the number of robots that will go to the 4th round can be changed by the referees

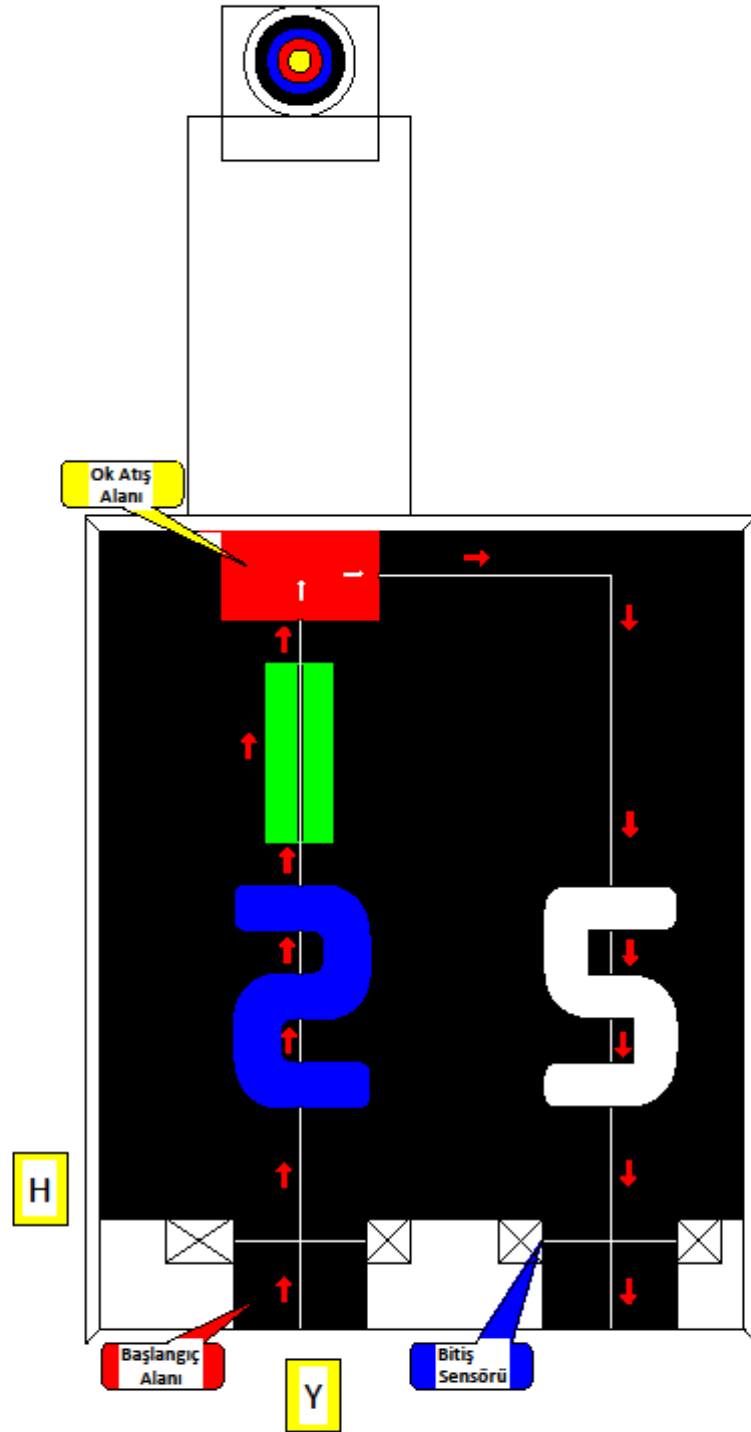


Figure-4: first round's route and Robot movements

#### OTHER RULES

- There is no break, maintenance or repair time.



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In cases where there are too many applications for the competition, if it is requested to finish early or if the competitions cannot be completed within the specified time for any reason (health, epidemic, heat, etc.), 1 more track can be added to the existing 2 tracks.

- No permanent mark or marking can be left on the track and it cannot be damaged. Robots that damage the track will be disqualified.
- Vehicles can use any energy source that will not harm the track and spectators.
- In case of remote access to robots, robots will be disqualified.
- Matte green foil, matte blue foil, matte red foil will be used for the colored zones on the competition track.
- The dimensions of the tracks may be changed during the construction phase without disturbing the general structure.
- Objections made during the competitions due to the lighted marquee, camera and lighting around the track will be considered invalid.
- The Competition Organization Committee has the right to change the rules when it deems necessary