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# Humanoid Archery

## Standard / Extreme

League  
Junior/  
Challenge

Participation  
1 Person 1 Robot

Construction  
Pre-made

## 1. Game background Description

Archery refers to the sporting event that uses a bow to shoot arrows. The word comes from the Latin arcus. Historically, archery has been used for hunting and warfare. In modern times, it is mainly a competitive sport and recreational activity. For the 20th IRO, the game of archery will be performed by the humanoid robots. This game category aims to encourage students to research on abilities of humanoids to perform and complete complex mission.

## 2. Rules

**2-1. Type of robot:** It must be authorized articulated two-legged walking humanoid robot. Only below robot types are allowed in the Standard Category.

Company	kit
Robotis	Bioid Premium
Roboro	Romanbo
Minirobot	MF-17RTW
LEJU Robot	AELOS AL-DC-C1.C

### 2-2. Composition of robot

#### 2-2-1. Construction: pre-built

All robots must be pre-built before the competition and built time is not given in the site of the competition.

#### 2-2-2. Classification into standard and extreme

- 1) Standard: It indicates regular humanoid first version from the beginning and approved by IROC, these robots are allowed to participate the competition. Only above robot types are allowed.
- 2) Extreme: It can use any components and items and all humanoid can join the

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competition.

- 3) Allowed accessories (Must be separate items from the robot)
  - o Bow with string
  - o Arrow with suction cup tip at one end



- The only modification allowed in the robot is the addition of a bow and an arrow. The bow and arrow must be separate and removable from the robot. The arrow's tip must be attached with a suction cup or suction tip that will allow the arrow to stick to the target once it is shot. The referee may disallow any arrows that violate this rule.
- 4) Prior to the commencement of the round, the robot must be presented to the referee as three separate pieces:
    - The Humanoid Robot (without any accessories)
    - Bow – can be made of any material or style but crossbow device is not allowed): Bow is curved piece of wood, plastic or metal whose ends are joined by a taut string.
    - Arrow – can be made of any material but the end tip (pointing towards the target) must be attached with a suction cup.
    - Pre-loading of bow and arrow to the robot – the bow and arrow will be attached to the robot by any means but only upon the official commencement of the round by referee's whistle.
  - 5) The robot's bow and arrow (not yet pulled) will be pre-loaded to the robot by the player upon commencement of the round and only while the robot is still within the Field Entry Range (please refer to illustration A3) . When the robot starts walking and steps outside the Field Entry range, the player is not anymore allowed to touch the robot. During the game progress, the robot must be the one to pull the bow string and apply the tension that will propel the arrow onto the target board. There should be no

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outside intervention that will control the releasing of the arrow. The use a crossbow like device is also not allowed.

## 2-3. Power

2-3-1. Robots should work with an independent electric power supply; it cannot use a combustibile device.

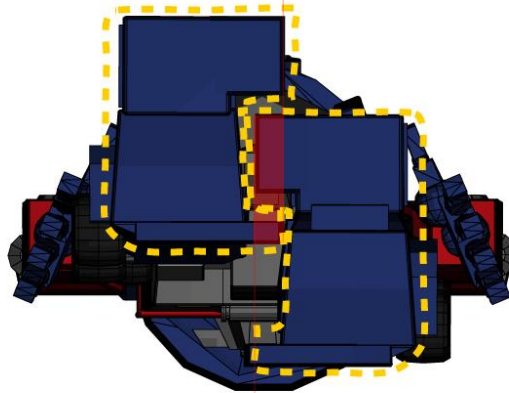
2-3-2. There is no limitations on type of battery or voltage level.

## 2-4. Operation

2-4-1. It should be two-legged walking as an articulated robot without linking structure

2-4-2. While it is standing, both feet should not cross the area.

ex



<While robot is standing, feet should not cross like above picture>

## 2-5. Programming and control

2-5-1. Programmed and remote-controlled robots are allowed during game progress.

2-5-2. Control communication specification

2-5-2-1. Only Zigbee /Bluetooth /2.4Ghz wireless are allowed to use.

2-5-2-2. Smart phone is allowed to use as a controller but make sure that it is flight mode in the competition area.

2-5-2-3. Wired control is not allowed.

2-5-2-4. When communication system is interrupted, any team couldn't change channel or if changed channel doesn't work, will be disqualified.

## 2-6. Spare robot

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#### 2-6-1. Robot preparation

Participant can prepare and bring spare robot to competition site and both main and spare robots should be confirmed by referee before match.

#### 2-6-2. Spare robot use

It is not allowed to switch robots during the match. Before the match starts, it can be changed after confirmation by referee. Spare robot must be confirmed to belong to same player. Strictly NO borrowing of robot between and among players is allowed.

### 3. Site Competition

**3-1. Competition site:** It must get an approval from International Robot Olympiad Committee.

#### 3-2. Size and composition

The size of playfield has to be 160cm X 120 cm ( $\pm 10\%$ ) and each participant uses only one playfield.

3-2-1. Less than  $2^\circ$  gradient ( $\pm 10\%$ ) and 0.3cm ( $\pm 10\%$ ) irregularity or crack is possible to exist in playfield.

3-2-2. Anything including acrylic wall will not be installed surround in the competition to prevent fall of the robot.

**3-3. Playfield** It is cover with matt coat polyethylene terephthalate paper which includes advertisement and logo from the organizers.

3-3-1. The Playfield Map shall measure 160cm x 120cm ( $\pm 10\%$ )

3-3-1-1. The field map is divided into parts: the field entry range range, the shooting distance range, shooting distance, and target board range.

3-3-1-2. The field entry range shall measure 20cm x 30cm ( $\pm 10\%$ ). This area is where the robot handler shall place the robot on its initial position. The robot handler may power up and initiate the robot program either directly or via remote control only within this area. The robot handler may also pre-load the bow and arrow to the robot only in this area.

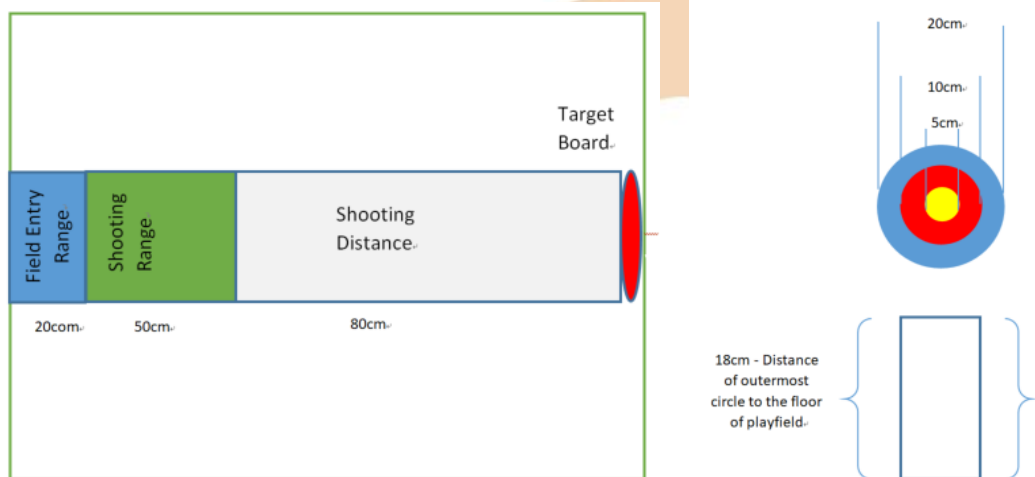
3-3-1-3. After initiation, the robot must walk towards the shooting area which measures 20cm x 50cm and must not cross the shooting range borderline.

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From the shooting range, the robot must pull the string of the bow that will propel the arrow on to the target board.

- 3-3-1-4. The robot and any of its part, including the tip of the arrow, is not allowed to cross or go beyond the shooting range. A penalty of 1 point will be deducted from the player's score for every violation. The robot must correct its position or go back to the shooting range when it violates this rule. There shall be a 1-inch-high divider line that will separate the Shooting Range from the Shooting Distance.
- 3-3-1-5. The robot must correct its position or return to the shooting range before attempting to release the arrow. An arrow released while the robot is in violation of 3-3-1-4 rule will not be given any score.
- 3-3-1-6. From the shooting range, there shall be an 80cm-shooting distance until the target board. The target board will be firmly positioned at the end side of the target range area. The Target Board shall be made of glossy sticker on sintra board material.
- 3-3-1-7. The robot is given 2 minutes per round to complete the task. When the time is up, the referee will signal the termination of round with a whistle.





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Field Entry Range	20cm x 30cm
Shooting Range	50cm x 30c m
Shooting Distance	80cm

### 3-4. Appendage of Competition

3-4-1. Bow - can be made of any material and to be supplied by the player. Any part of the bow must not extend beyond the shooting range. The bow must have a string that the robot will pull in order to supply the propulsion needed to release the arrow. Crossbow device or the like is not allowed.

3-4-2. Arrow - can be made of any material and to be supplied by the player. Any part of the arrow including the tip must not extend beyond the shooting range. The tip of the arrow must be attached with a suction cup. The referee may require the player to replace his arrows if it is in violation of this rule.

3-4-3. Target Board - the target board is made of glossy sticker on **sintra** board.

## 4. Competition progress

### 4-1. Game process

4-1-1. Only one robot is allowed during the game progress.

4-1-2. The game begins with the referee's blowing of a whistle and the game terminates with the referee's blowing of a whistle the second time.

4-1-3. The player must not interfere in any way with the robot or the referee. The round will be terminated when the player violates this rule. The player will not earn any score.

4-1-4. The player may only touch the robot with the permission of the referee. The shooting will be declared invalid if the handler touches the robot without referee's permission.

4-1-5. The referee may terminate the round immediately on the following occasion:

4-1-5-1. When the angle of shooting of the bow and arrow is aimed in such a way that it may hit other spectators or participants.

4-1-5-2. When the 2 minute maximum duration of the round has elapsed.

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4-1-5-3. When the robot damages the holder or playing field.

4-1-5-1. When the robot leaves the start zone or the shooting range and has not corrected its position within 10 seconds.

4-1-6. The player may only touch the robot with the permission of the referee. The shooting will be declared invalid if the handler touches the robot without referee's permission.

## 5. Match

**5-1. Start** A participant should start the robot when the referee starts the game.

5-1-1. False start

If the participant starts the robot before the referee's signal, it is declared as 'False start' and the player will have only one more chance to restart.

5-1-2. Restart

The chances to restart are only once and if it is declared as 'false start' twice by referee in a game, it will be disqualified.

**5-2. Time limit**

Each round will be given 2 minute duration.

**5-3. Match decision**

5-3-1. Time limit

If robots couldn't complete the missions within 2 minutes, it will record the point when the match ends.

5-3-2. Robot stop (Malfunction)

If the robot doesn't move during match or hovers same areas constantly during match, the referee will count 10 seconds. If the robot still cannot move, referee calls it a robot stop and the robot will be excluded from the match. Opponent robot will continue its match.

5-3-3. Robot falls

When robot falls off the playing field, referee will pick up the robot on the place where the robot falls and continues the round without stopping the timer.

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#### **5-4. Disqualification**

##### **5-4-1. Robot touch**

During matches, if participants touch the robot without judge's approval and supervisor authorization, it will be declared as 'Robot Touch' and it will be disqualified for that trial.

#### **5-5. Rematches**

During the match when it had been black out and breakdown of measuring instrument happens referee and supervisor can make a decision to do rematch.

**5-6. Referee will control all situations from and referee have authority to control participants. The judgment of game result is exclusive authorization of referee. The declaration shall be final.**

### **6. Evaluation**

**6-1. Ranking decision factors:** Participant who gets more points during the limited time.

#### **6-2. Scoring and determining the winners**

6-2-1. There shall be three rounds in the game. When all the players have finished each round will the succeeding round will commence. The highest point from the three rounds will be counted as the official score of the player for the game. The winners with the highest points will be declared as the winners.

6-2-2. A robot scores if the arrow sticks on the target board. The score points to be earned by the robot are dependent on where the arrow will remain stuck on the scoring area of the target board. For a robot to earn points, the arrow must remain stuck even after the elapse of 3 seconds upon hitting the board.

6-2-3. Any arrow that will fail to stick to the board and fall to the floor or any area except the target board will not be given any score. Please see the score table below.



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Position of arrow	Points
Yellow circle (center – 5cm diameter), without the arrow landing on the line surrounding it.	5
Red circle (middle – 10 cm diameter) or any part of the line surrounding the yellow circle	3
Blue circle (outer circle – 20 cm diameter) any part of the Blue Circle or any part of the line surrounding the red circle	1

6-2-4. Any robot that has not scored a single point is automatically awarded 0 rank.

6-2-5. Among the robots that have gained least one point, the robots are ranked (i.e., 1st place, 2nd place) based on the greater number of points that the robot scored.

#### **6-5. Tie Breaker**

6-5-1. In case of a tie, i.e., more than one robot having scored the same number of points, the robots will be ranked based on the sum of their score point over all rounds.

6-5-2. In case one or more robots have scored the same number of points and are still tied after applying the previous tiebreaker, another round will be called only for the tied robots.