STEM education
ORGANIZATION OF EDUCATIONAL ROBOTICS, SCIENCE, TECHNOLOGY & MATHEMATICS

Educational Robotics contest 2024

Mediterranean Football Cup

Football 2x2 - Primary school level

Rules and game description

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Version: 2023

A. Brief Game Description

2x2 Football is designed for elementary school students. In this game, two opposing teams, each consisting of two remote-controlled robots, chase a ball on a specially designed table (football field). The goal of each team is to win the game by scoring more goals than their opponents.

B. Participants

- **Age**: Students in grades 3 to 4, born between January 1, 2013, and December 31, 2014.
- **Team**: Minimum of 2 and maximum of 3 children.
- **Coach**: Must be 20 years old or above.

C. Educational Objectives

Educational Robotics serves as an excellent learning tool that helps students acquire essential skills required in our modern era. By engaging in challenges, students develop problem-solving abilities, nurture their creativity, take initiatives, experiment with solutions, and generate innovative ideas. An exceptional aspect of Educational Robotics is its unique connection between various cognitive fields. Through this discipline, students apply theoretical knowledge acquired from Mathematics, algorithms, programming, mechanics, and Physical Sciences.

One of the most significant contributions of Educational Robotics to education is its combination of learning with entertainment (playful learning), promoting collaboration. Students learn to work in teams, fostering creativity, and cultivating learning in a way that is as experiential and natural as breathing.

Specifically, this 2x2 football competition is designed to practically apply the aforementioned pedagogical principles of Educational Robotics. Its added pedagogical value can be summarized as follows:

1. Provides an opportunity for children to engage with Educational Robotics in a smooth manner, as the competition does not require robots with automation but focuses more on the constructional aspect. A simple robot with minimal equipment is sufficient, as the ultimate goal is to develop a positive attitude and demystify Educational Robotics.
2. Ensures to a great extent that the construction and programming are carried out by the students themselves. The construction and (visualized) programming skills required are simple, making it achievable for elementary school children (it does not involve complex connections or algorithms).
3. Readiness, decision-making, and taking initiatives are present throughout the game, not just during preparation before the match. This sharpens the perception of participants, sustains their interest, and creates a pleasant atmosphere filled with surprises and excitement.

4. Fosters a climate of collaboration and teamwork (through team communication), which is a fundamental ingredient of creativity in today's world, while promoting a spirit of fair competition.

D. General Game Principles

According to the educational objectives, the following general principles should be strictly adhered to:

1. The robots should be constructed and programmed exclusively by the students.
2. Similar to real football, the decisions made by referees are final. The result of a match cannot be changed unless an error is found in the score counting.
3. Students and their coaches should collaborate in a way that does not violate the educational objectives of the game. Both parties should also assist in the smooth conduct of the matches.
4. The most important aspect is not winning or losing but the participation itself and the excitement that a football match brings.
5. The organizing committee has the right to disqualify a team from the competition if they attempt to use unfair means that contradict the spirit of fair competition with equal conditions, which are not explicitly provided for in the present rules.
6. The game rules may be modified by the responsible parties of the category and the organizing committee before the start of the tournament and should be communicated to the players to maintain the pedagogical spirit and smooth conduct of the matches. They also have the authority to instruct the judges to intervene in the field or goals in case they have suffered damage or displacement.

E. 2x2 Football Rules

1. Team of Students

1.1. Each team participating in the competition must construct and program **only one** robot.

1.2. Substituting a robot for any reason is prohibited. Teams that replace any of their robots during the matches will be disqualified from the tournament.

1.3. Each team can consist of 2 or 3 students and one coach.

2. Team Alliances

2.1. An alliance consists of 2 teams of students

2.2. In each football match, two opposing alliances compete against each other

2.3. Before each match, the alliances are given time to discuss and determine their in-game strategy.

3. Scoring

3.1. A goal is scored when the ball fully crosses the goal line.

3.2. The alliance that scores the most goals wins the game.

3.3. If the ball, while moving towards the goal, touches a defending robot with any part of it inside the goal, the referee will award a goal to the defending alliance.

4. Match Duration

4.1. The match has a total duration of 8 minutes.

4.2. There is no halftime. The teams keep the same goals throughout the 8 minutes of the game.

4.3. During the match, time runs continuously without any clock stoppages.

4.4. When the teams are not competing, they have the opportunity to repair and reprogram their robots.

5. Gameplay

5.1. At the start of the match, the ball is placed on the white dot on the center line. All robots must have some part of them behind the white line of the defending zone.

5.2. The match begins with the referee's command. All robots must be activated immediately after the referee's command.

5.3. If an alliance scores a goal, without stopping the time, the ball is placed on the center line and given to the alliance that conceded the goal. The robots of the alliance that scored the goal are positioned so that some part of them is behind the white line of the defending zone. The alliance that conceded the goal positions one robot in its zone, with some part of it behind the white line. The second robot is positioned on the center spot, right behind the ball, to initiate a new attack.

Image 1: *Indicative Placement of Robots at the Start of the game*

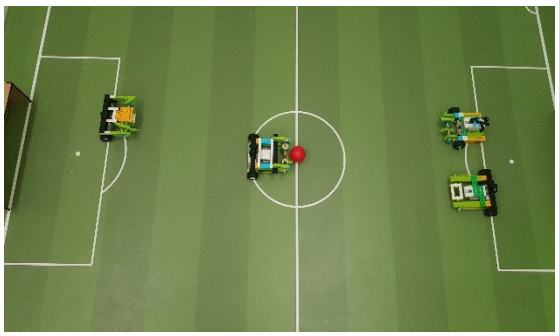


Image 2: *Indicative placement of robots after scoring a goal*

5.4. If two opposing robots collide, the referee has the authority to separate them, moving them as minimally as possible.

5.5. The referee will blow the whistle for a "push" as soon as it is observed that a robot, while attempting to claim the ball located behind an opponent's robot, forcefully pushes it to drag it inside the field. After the whistle, the ball is placed at the center line, and the game continues without stopping the time. It is understood that if a goal is scored as a result of the pushing, it is nullified.

5.6. **"Deliberate pushing"** is prohibited for a robot to perform on an opponent when, for example, the ball is out of play, with the intent of preventing its approach. If it is determined that there is no intention to compete for the ball, the robot causing the push is placed, as directed by the referee, in the right corner (corner kick) of the defending area (if the conflict occurs on the left side of the field) or in the left corner (if the conflict occurs on the right side of the field), and the game continues from there (see 6.2 for the method of resumption).

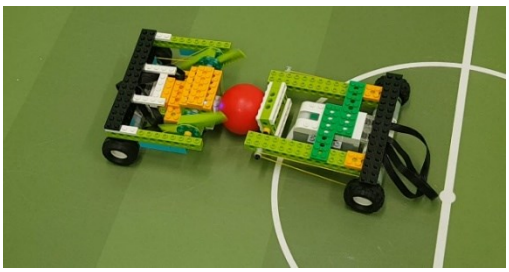


Image 3: *Pushing an opponent with the intention to claim the ball*

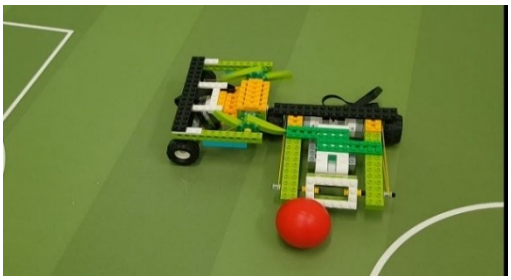
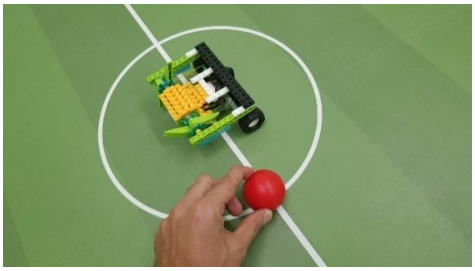
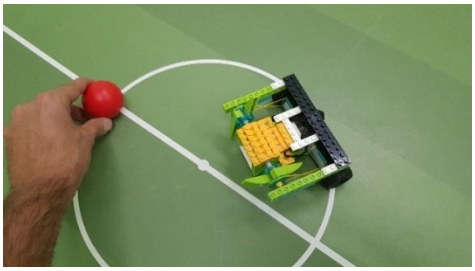


Image 4: *Deliberate pushing of an opponent"*

5.7. Players are not allowed to touch their robots throughout the duration of the game without the permission of the referee.

5.8. If the ball goes out of bounds (outside the field behind the goals), it is immediately returned by the referee to the white spot located on the center line. If at that moment a robot is present on the white spot, the ball is placed as close as possible to the center spot but not directly in front of the robot. Preferably, it is placed to the right or left on the central line at the intersection point with the center circle, in order to avoid giving advantage to any robot.





Images 5 & 6 *Alternative points of placing the ball at the center line*

5.9. There is no sideline throw-in. The field will have slopes on the sides, and the ball will return to the playing area on its own.

5.10. If both robots of the defending alliance are inside their own penalty area and their positions affect the game, the referee will call a **"double defense."** In this case, the robot that has a lesser impact on the game, as indicated by the referee, will be moved to the center spot by the team players, so that a part of the robot touches the center line.

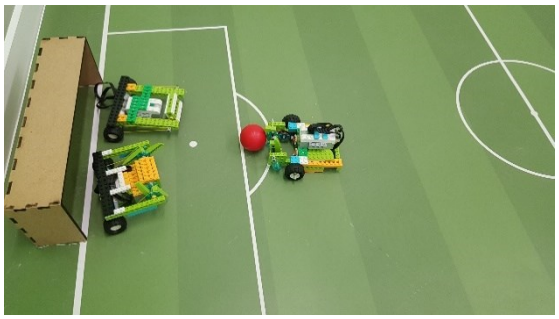


Image 7 *An exemplary case of double defense*

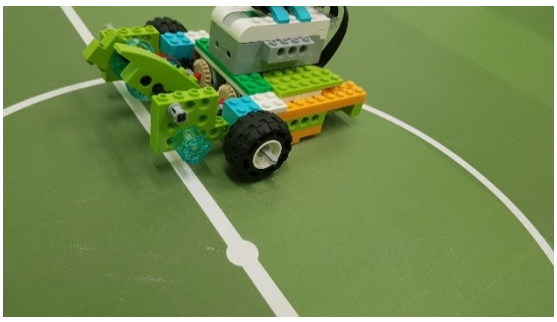


Image 8 *Indicative placement of the robot at the center line, due to the penalty for double defense*

5.11. It is prohibited for any robot of the defending alliance to remain stationary intentionally in front of the goal or to move parallel to the goal line for more than 3 seconds. If the referee determines that the ball was obstructed from progressing towards the goal in this manner, the robot is expelled as "damaged" and returns to the playing field after a 1-minute penalty from the corner (see 6.2 for the return procedure).

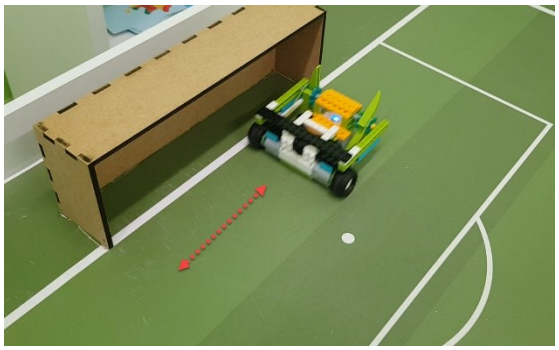


Image 9 *Continuous movement parallel to the goal post for an extended period is punishable by a 1-minute expulsion.*

6. Damaged Robots

6.1. A robot is deemed "damaged" by the referee when:

- Any part of it has been disassembled.
- It remains motionless (communication with PC or tablet is lost).

- The alliance intentionally removes one of its own robots from the game for any reason.

6.2. A "damaged" robot stays out of the playing field until repaired by the players. Immediately after receiving permission from the referee, it returns to the game. The returning robot is placed at the corner of the defensive area, either on the right or left, as chosen by the players. However, it is forbidden to position it in a way that gives it an advantage in ball possession, such as directly in front of it. The referee may indicate from which side the robot should return if it creates such an advantage.

6.3. If a robot turns over for any reason, with the assistance of the referee, it is lifted back up and continues the game.

6.4. If both robots from an alliance are deemed "damaged" and are out of the game, the match continues as normal. The timer is paused when all four robots are damaged and resumes when at least one robot returns to the playing field.

6.5. If, during the recovery process, one of the robots is damaged due to the referee's fault in disentangling them, the timer stops, and the team is given time to repair the robot. In this case, no robot is moved until the damaged robot returns to its original position. The ball is placed where it was, provided it was moved after the interruption. The timer restarts, and the match continues normally.

Image 10 *Placing robots back into the match after being marked as damaged*

7. Construction Specifications for Robots

7.1. Only LEGO parts are allowed for robot construction.

7.2. Wheels (tires and rims) must be exclusively from the LEGO WeDo 2.0 package or equivalent package versions.

7.3. Teams must use two Smarthubs and motors from the LEGO WeDo 2.0 robot kit or equivalent package versions.

7.4. Each robot must have at least one mechanism for shooting, that is, a construction at the front (only) that shoots the ball.

7.5. One Smarthub should be connected to two motors for robot movement, while the other Smarthub should be connected to motor(s) exclusively controlling the shooting mechanism**. One player in each team must handle the shooting, and another player must control the robot's movement**.
7.6. Modification or alteration of LEGO pieces is prohibited.
7.7. No other materials, such as glues, tapes, screws, etc., are allowed for robot assembly.
7.8. LEGO Mindstorms balls with Part Number 41250 (52mm in diameter) will be used as the footballs.
7.9. The robots will not be autonomous but controlled remotely. In this year's competition, motion control and shooting must be performed using one or a combination of the following methods:
A) **Scratch** programming language with a keyboard or remote control.
B) **Microbit** board in conjunction with a fully programmable **remote control**. The Microbit is connected to the remote control, and then the Microbit is connected to **Scratch/Mind+** for controlling WeDo.
7.10. Pre-programmed movements are allowed in the program using Microbit.
7.11. Each robot must have **dimensions** not exceeding **17 cm in length**, **15 cm in width**, and **15 cm in height**.
7.12. Robot dimensions are measured when they are in an upright position with all their movable parts fully extended.
7.13. Cables are included in the measurement of robot dimensions.

8. Robot Assembly

8.1. Robot assembly will take place during the allotted assembly time provided to teams on the day of the competition.
8.2. Before the assembly time begins, all robots must be fully disassembled. For example, a tire should not be around a wheel.
8.3. Teams have a total of **60 minutes** to complete the assembly and test their robots on the field.
8.4. Participants are not allowed to use any help, such as instructions or drawings on paper, stored photos on a computer, etc.
8.5. Participants are allowed to use programs they have previously written (prior to the competition day).
8.6. Students are allowed to modify their constructions or programs from the moment they enter the competition area or during the breaks between matches. There will be no quarantine before or during the matches.
8.7. It is the teams' responsibility to ensure that their robots continuously meet all the specifications and restrictions set by the rules. If a robot is found to violate any construction rule after a match, the points earned in that match will be deducted from the alliance.

9. Ball Handling

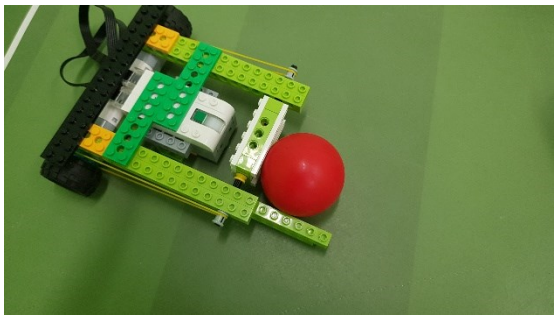
9.1. **"Ball Capture Zones"** are defined as all concave surfaces created when wrapping the entire robot tightly with plastic wrap.

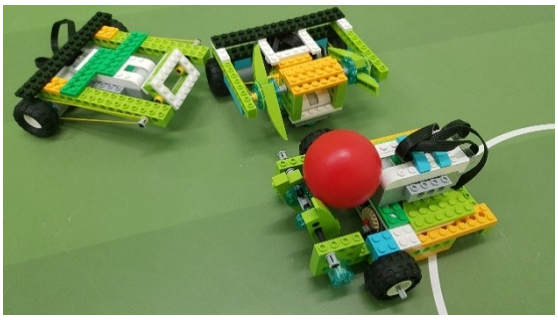
9.2. The ball is not allowed to penetrate more than 2cm into any "Ball Capture Zone".

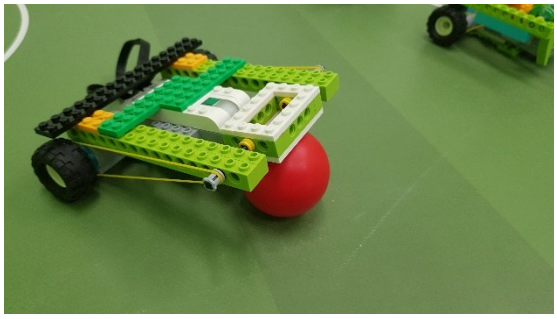
9.3. A robot is not allowed to capture the ball. This means that it should not remove any of its degrees of freedom. For example, the ball cannot be secured in any way on the robot, the ball cannot be surrounded by the robot, nor can it be trapped by any part of the robot (e.g., on top of it). If the ball stops rolling and starts dragging while the robot continues to push it or if the ball does not bounce off when hitting the robot, these are indications that the robot is capturing the ball.

9.4. The ball cannot be underneath a robot. Specifically, no part of the robot can extend over the ball more than half of its diameter.

9.5. In the event that a robot captures the ball, the referee places it at the center line without stopping the running time.







Images 11, 12 & 13 *Cases where the ball is "captured by the robot"*

THE BALL IS PLACED ON THE CENTER LINE	THE BALL CONTINUES ROLLING WITHOUT INTERFERENCE
When the ball crosses the end line parallel to the goal posts (5,8)	When the ball crosses the side lines of the field on the sloped plane
At the start of the match (5,1)	
When a goal is scored (5,3)	
When an opponent is charged with "pushing" (5,5)	When the referee calls "double defense" within the penalty area
When the ball gets stuck between two robots	When two robots get stuck together and are separated by the referee
When a robot captures the ball (9,5)	

THE ROBOT IS PLACED AT THE CENTER LINE	THE ROBOT IS PLACED IN THE CORNER
When the robots perform "double defense" (5,10)	When the robot intentionally pushes (5,6)
	When the robot remains deliberately in front of the goal or moves parallel to the goal line for more than 3 seconds (5,11)
	When a robot that was marked as "damaged" returns to the game (6,2)

10. Tournament Procedure

10.1. The tournament will be conducted in two phases: the qualifying phase and the knock out phase.

10.2. The qualifying phase will consist of 4 rounds (matches). In each round of this phase, alliances will be formed through draw.

10.3. In each game, the winning alliances will be awarded 3 points. In games ending in a draw, all alliances will receive 1 point.

10.4. In the qualifying phase, teams will be ranked in a unified scoring table.

10.5. In case of a tie in points, the following criteria will be applied in order of priority:

- Goal average
- Number of goals scored
- Winner of the match between the tied teams
- Which team won against the next highest-ranked opponent
- Draw

10.6. The top 16 teams from the preliminary phase will advance to the knockout phase.

10.7. The alliances in the final phase are fixed until the end of the tournament and are determined as follows: The 1st team allies with the 16th team, the 2nd team with the 15th team, the 3rd team with the 14th team, and so on.

10.8. The alliances compete in knockout games until the final.

10.9. In case a knockout game ends in a draw, the teams proceed to a **4-minute overtime**, where the **golden goal** rule applies (the alliance that scores first during the overtime period wins the game).

10.10. If no goal is scored during the overtime period, the game proceeds to a penalty shootout. Each alliance takes turns shooting 4 penalties (2 per robot) as follows: The ball is placed by the referee on the penalty spot at the center of the field, and each robot gains momentum and aims to shoot into an empty goal. The robots' wheels are not allowed to touch or cross the central line. Otherwise, their penalty is invalidated and not repeated.

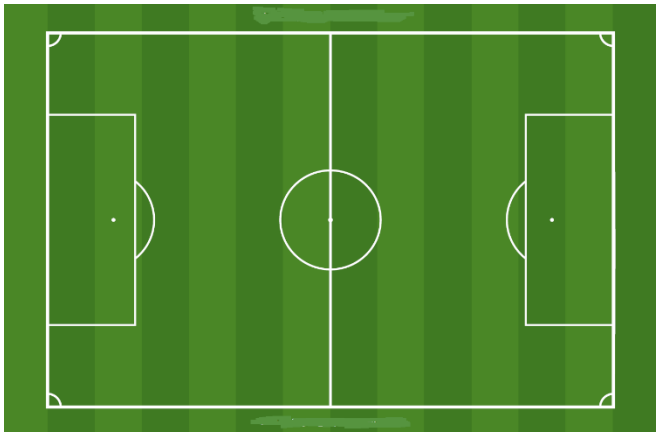
10.11. All robots shoot at the same goal, which is chosen by the two alliances. If they do not agree, the referee conducts a draw.

10.12. The teams from the alliance that wins the tournament share the 1st place collectively.

10.13. In case of a team's withdrawal, the game is played normally with the alliance competing with only one robot. The opposing alliance plays with its two teams as usual.

10.14. In case both teams from an alliance withdraw, the opposing alliance wins the match with a score of 2-0 in their favor.

11. Football Pitch



11.1. The printing of the floor will be done on a high-resolution canvas file that can be found on the WRO Hellas website.

11.2. The canvas dimensions are: **2100 X 1318 mm**.

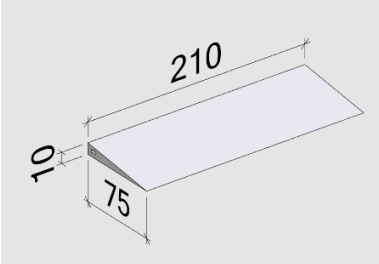
11.3. The playing area will be: **1815 X 1200 mm**

11.4. Dimensions of the Penalty Area: **287 X 645 mm**

11.5. The goal posts will have the following dimensions:

- Length: **35 cm**
- Height: **12 cm**
- Depth: **8 cm**

11.6. To improve the quality of the game, there is a possibility of placing inclined surfaces of dimensions 75mm x 10mm on the long sides of the pitch (e.g., 10 pieces of 210 mm length each). The purpose of the inclined surfaces is to prevent the ball from sticking to the side walls of the pitch and to push it towards the center. The height of the inclined surfaces may vary from pitch to pitch depending on the material used as a carpet. Ideally, when the ball is released from the top of the inclined surface, it should come to a stop in the center of the pitch.



F. Appendix: Examples of connecting 2 smart hubs

1st way

We follow the connection instructions on how to operate the WeDo 2.0 Bluetooth Hub with Scratch 2.0 on a Windows PC

Prerequisite steps ONLY for the first time:

1. Purchase the BlueGiga Bluetooth v4.0 USB dongle (hereafter referred to as "BLED"). See how it looks in the following photo:

2. For computers with Windows 10, insert the BLED into a USB port, and Windows 10 will automatically recognize it.
3. Now, we need to install the program that acts as an intermediary between the BLED and Scratch 2.0 (for Scratch, see the next step 4). Open our favorite web browser, enter the address: http://www.picaxe.com/Teaching/Other-Software/Scratch-Helper-Apps, scroll down the webpage until approximately the middle, and find the reference: "S2Bot App for Windows (MSI)." Click on it to download. Once we run and fully install it, the application icon will appear - ' '.

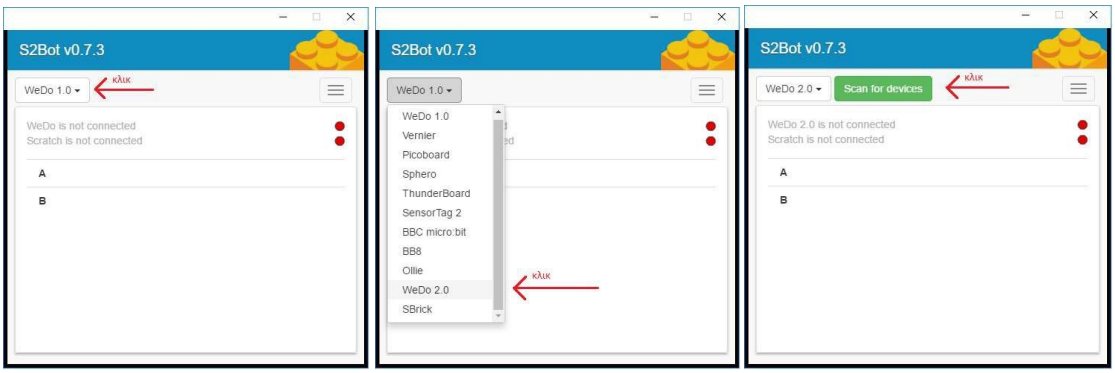
- “ .

4. Before installing Scratch 2.0 version 453 from MIT (note - only this version works properly), we need to install Adobe AIR. You will find both executable files in the same directory as this help file you are currently reading. If later, when the Scratch 2.0 application opens, it suggests upgrading to a newer version, NEVER accept it! These are the prerequisite actions for the first time. We don't need to perform them again.

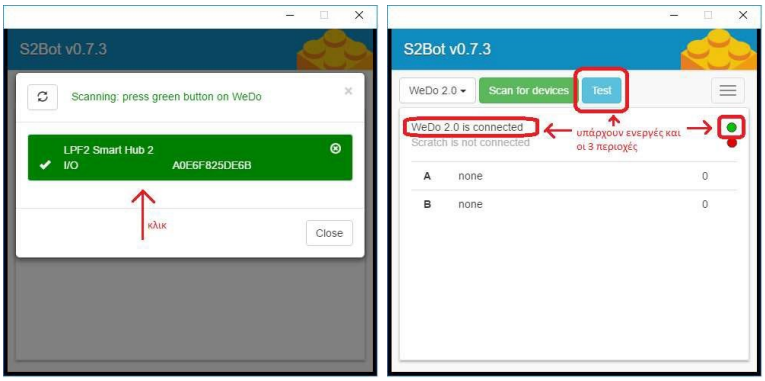
The steps we perform EVERY time we want to operate WeDo 2.0 from Scratch 2.0:

1. Launch the "S2Bot for Scratch" application from its shortcut (it is advisable to pin it to the taskbar in advance).

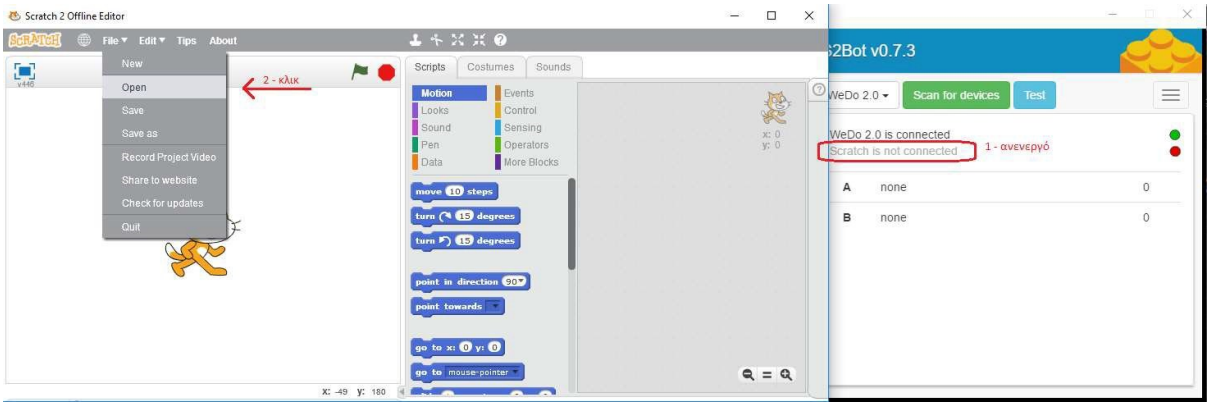
2. Select the "WeDo 2.0" device from the hidden device list on the left button, if it is not already selected. The first time, the "WeDo 1.0" device is preselected. As soon as we do it, a green button labeled "Scan for devices" appears - see the 3 photos below:

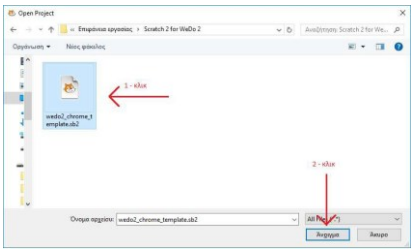


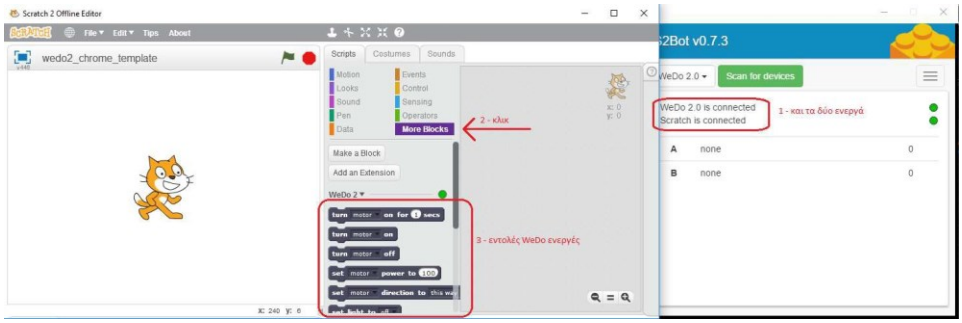
3. Press it, and the message "Scanning: press green button on WeDo" appears. Press the green button on the Hub, and once the Hub is detected in the application, select it. The selection locks in a few seconds. If it is not detected, close the application, remove the BLED from the USB port, and retry the steps - see the following 2 photos:



4. Launch Scratch 2.0 and open (select "File – Open") the file "wedo2_x1_template.sb2" that you can find online. Then, from the Scratch 2.0 menu, select "More Blocks," and in front of us, all the commands related to WeDo 2.0 functionality will appear - see the photos below.







5 If we want to connect additional WeDo 2.0 hubs, we repeat steps [3] and [4] using the files "wedo2_x2_template.sb2" (for 2 hubs). Caution: The ports will now become 4 or 6 with the names A, B (for the first hub), C, D (for the second hub). When connecting 3 hubs, ports C and D may not appear. Don't worry, all 6 ports function properly through Scratch 2.0.

2st way


One smarthub is connected and controlled with **S2Bot for Scratch** (app with the gray gear) and the **Scratch 2 software** (version 4.5.3), while the other is connected with a microbit using the supported remote control, controlled by the Mind+ software. Both applications are available for free online.