STEM education
ΟΡΓΑΝΙΣΜΟΣ ΕΚΠΑΙΔΕΥΤΙΚΗΣ ΡΟΜΠΟΤΙΚΗΣ, ΕΠΙΣΤΗΜΗΣ, ΤΕΧΝΟΛΟΓΙΑΣ & ΜΑΘΗΜΑΤΙΚΩΝ

National Educational Robotics Competition 2025

Football 2x2

Game description and rules

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Release: October 2024

A. Brief Description of the Game

Football 2x2 is addressed to primary school students. In this game 2 rival alliances consisting of 2 remotely controlled robots each, chase a ball on a specially designed table (football field). The goal of each alliance is to win the game, scoring more goals than their opponents.

B. Participants

- **Ages:** B' – D' Primary School (born from 1/1/2015 to 31/12/2017)
- **Persons per group:** minimum 2 / maximum 3 children
- **Coach** (over 20 years old)

C. Educational objectives

Educational Robotics is a wonderful learning tool that helps students acquire all those necessary skills that our time requires. Students who are trying to complete tests, are trained in problem solving, cultivate their creativity, take initiatives, test experimental solutions and generate innovative ideas. A special feature of Educational Robotics is that it connects many different fields of knowledge in a unique way. Thus, through it, students synthesize and apply in practice the theoretical knowledge they have acquired from Mathematics, algorithms, programming, engineering and Natural Sciences.

Perhaps the most important contribution of Educational Robotics to education is that it combines learning with entertainment (playful learning), promotes cooperation as students learn to work in teams and, in general, cultivates learning in a way as experiential and natural as our breathing. In particular, this 2X2 football competition is designed in such a way as to give the opportunity to apply in practice the above pedagogical principles of Educational Robotics. Specifically, its added pedagogical value is summarized as follows:

1. It gives children the opportunity to engage with Educational Robotics in a smooth way, as participation in the competition does not require robots with automation, but focuses more on the construction part. It only requires an elementary robot with the minimum possible equipment, as the ultimate goal is to form a positive attitude and demystify Educational Robotics.
2. It ensures to a large extent that construction and programming are the personal work of the children themselves, as the requirements in construction skills and knowledge of (visualized) programming are simple, so that it is feasible for primary school children to respond (they do not require complicated connections or algorithms).
3. Readiness, decision-making and initiative are present throughout the game - and not only during the preparation before the match - sharpening the perception of the participants, maintaining undiminished interest and creating a pleasant atmosphere of action, full of surprises and emotions.

4. A climate of cooperation and teamwork is created (through team communication), which nowadays is a key component of creativity, but also promotes a spirit of fair play.

D. General Principles of Gambling

According to the educational objectives, the following general principles should be applied irrevocably:

1. Robots should be built and programmed solely by students.
2. As in real football, the referees' decisions are final. The result of a match cannot be changed unless a mistake has been made in the score measurement.
3. Students and their coaches should cooperate in such a way that the educational objectives of the game are not violated. Both should also help to ensure the smooth running of the games.
4. What counts most is not the win or defeat, but the participation itself and the thrills of a football match.
5. The organizing committee has the right, at its discretion, to expel a team from the competition if it finds that it is attempting to use unfair means contrary to the spirit of healthy competition on equal terms not expressly provided for in these rules.
6. The rules of the game may be modified by decision of the league officials and the organizing committee before the start of the tournament and announced to the players, in order to maintain the pedagogical spirit and the smooth conduct of the matches. They also have the right to instruct the judges to intervene on the track or hobs in case they have been damaged or moved.

E. 2x2 Football Rules

1. Group of students

1.1. Each group of students taking part in the competition will have to build and program only **one** robot.

1.2. It is forbidden to replace a robot for any reason. Teams that replace one of their robots during the games are eliminated from the tournament.

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

2. Group Alliances

2.1. An alliance consists of 2 groups of students

2.2. In every football match, 2 rival alliances collide.

2.3. Before each match, alliances will be given time to discuss and define their in-game strategy.

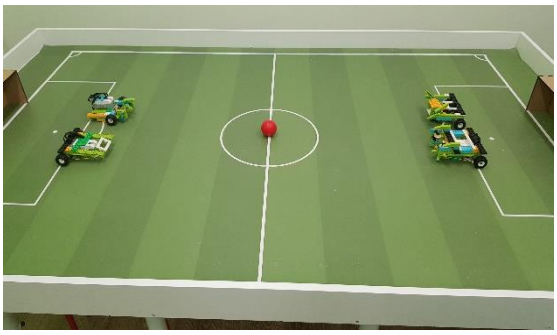
3. Scoring

3.1. Goals are scored when the ball crosses the entire 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 whose part is inside the goal, then the referee will charge the defending alliance with a goal.

4. Race



Duration

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

4.2. There is no half-time. The teams maintain the same goalposts throughout the 8 minutes of the game.

4.3. During the race, time flies continuously, without stopping the clock at all.

4.4. When teams aren't racing, they have the ability to repair and reprogram their robots.

5. Racing Action

5.1. At the start of the match, the ball is placed in the white dot in the center of the field. All robots should have some part behind the white line of the area they are defending.

5.2. The match starts by order of the referee. All robots should be switched on immediately after the referee's order.

5.3. If an alliance scores a goal, then, without stopping time, the ball is placed in the center of the field and given into the possession of 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 area they are defending. The alliance that conceded a goal places one robot in its area, with a section of it located behind the white line. The second robot is placed in the center, just behind the ball, to carry out a new attack.

Figure 1 *Indicative placement of robots at the start of the race*

Figure 2 *Indicative placement of robots after goal achievement*

5.4. If 2 rival robots stick together, then the referee can distinguish them, moving them as little as possible.

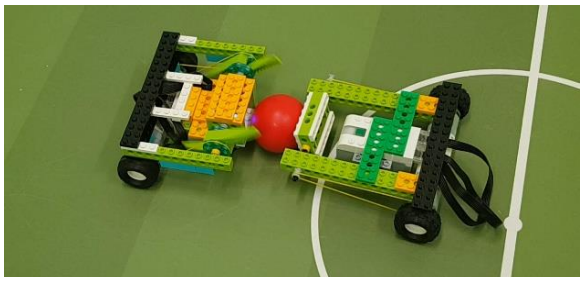


Figure 3 *Pushing an opponent in order to claim the ball*

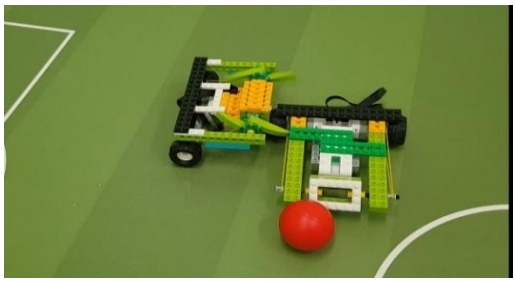
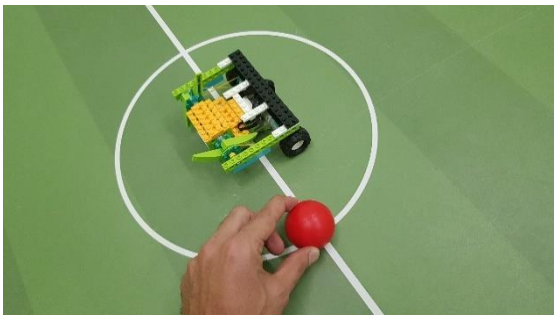
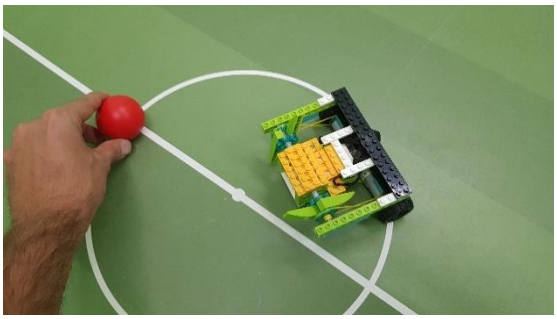


Figure 4 *Deliberate pushing of an opponent*

5.5. The referee will blow the whistle as soon as it is found that a robot, trying to claim the ball behind an opposing robot, pushes it with such force as to drag it into the field. After the whistle, the ball is placed in the center of the field and the game continues, without stopping time. It goes without saying that if a goal is scored, due to pushing, it is canceled.





Figures 5 & 6 *Alternative ways of placing the ball in the center*

5.6. **"Deliberate pushing"** is forbidden for a robot to perform on an opponent, when, for example, the ball is out of phase, in order to prevent it from approaching. If it is determined that there is no intention to claim the ball, the robot causing the push is placed at the referee's suggestion in the right corner (corner) of the defense area (if the dispute is on the left side of the field) or on the left (if the dispute is on the right side of the field) and Continue the game from there (see 6.2 for how to return).

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

5.8. If the ball goes out (outside the boundaries of the field behind the goalposts), it is immediately returned by the referee to the white dot located in the center of the field. If at that moment there is a robot on the white dot, then the ball is placed as close as possible to the white dot, but not directly in front of the robot located there. It is preferably placed right or left on the center line at the point of intersection with the circle of the center, so as not to give an advantage to a robot.

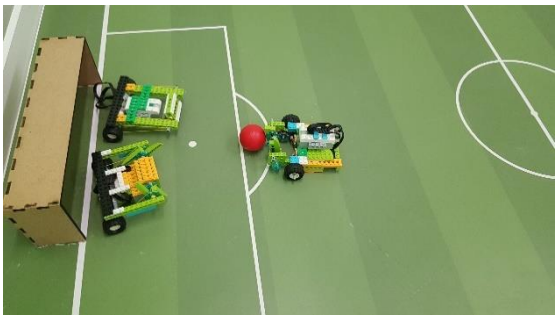


Figure 7 *Illustrative case of double defence*

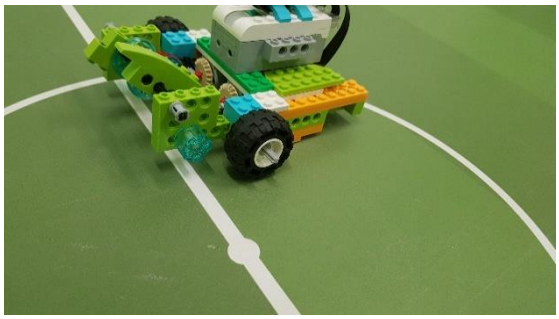


Figure 8 *Indicative placement of the robot in the center, due to the penalty for double defense*

5.9. There is no collateral out. The track will be tilted to the sides and the ball will return to the pitch on its own.

5.10. If all 2 robots of the defending alliance are within their range and their position affects the game, then the referee will whistle **"double defense".** In this case, the robot that least affects the game - according to the referee's suggestion - will be transferred to the center of the field by the team players, so that a part of the robot touches the center line of the field.

5.11. It is forbidden for a robot of the defending alliance to stand still in front of its goal intentionally or move parallel to the goal line for more than 3 seconds. If it is determined by the referee that the ball was prevented from heading towards the goal in this way, the robot is sent off as "damaged" and returned to the pitch after 1 minute of penalty from the corner (see 6.2 for the way to return).

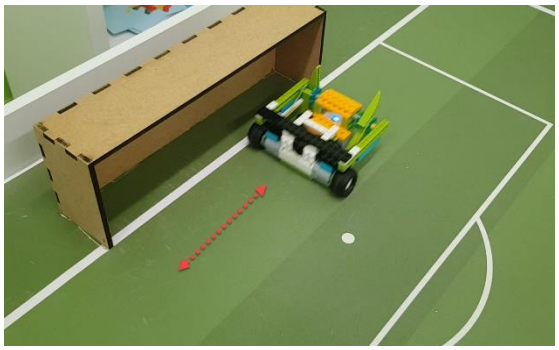


Figure 9 *Parallel to the hearth movement for a long time is punishable by expulsion for 1 minute*

6. Damaged Robots

6.1. A robot will be marked **"damaged"** by the referee when:

- some part of it has been dismantled,
- remains stationary (communication with PC or tablet is lost)
- If the alliance wants for whatever reason to take one of its own robots out of the race

6.2. A "damaged" robot remains off the field until the repair is completed by the students. Immediately afterwards and after permission has been given by the referee, he returns to the match. The robot returning to the match is placed in the corner of the corner of the defense area, right or left when selecting players. However, it is forbidden to position himself in a position that gives him an advantage in possession of the ball, e.g. directly in front of it. The referee can indicate from which side the robot will return, if he considers that such an advantage is created.

6.3. If a robot flips over for any reason, with the help of the referee it gets up again and continues the game.

6.4. If both robots from an alliance are classified as "damaged" and exit the game, the race proceeds normally. The timer is interrupted when all four robots are destroyed and resumes when even one robot returns to the field.

6.5. If during the recovery process the robots are damaged by the fault of the referee who untangles them, then the timer stops and the team is given time to repair the robot. In this case, no robot moves until the damaged robot returns to where it was. The ball is placed in the position it was in, since it was moved after the break. The timer starts again and the race continues normally.

Figure 10 *Placement of robots to return to the race, after being classified as damaged*

7. Robot Specifications

7.1. Only LEGO pieces may be used for the construction of robots.

7.2. The wheels (tires and rims) must be exclusively from the Wedo 2.0 package or its equivalent packages.

7.3. Teams will be required to use a single Smarthub and 2 motors from the LEGO WeDo 2.0 robotic kit or its equivalent packages.

7.4. Each robot **can optionally have at least one mechanism for shooting**, that is, a built-in structure in the front (only), that gives the ball a boost. This mechanism will be connected to the engines. Therefore, when moving the robot (in any direction) it should necessarily also move.

7.5. Modification or alteration of LEGO pieces is prohibited.

7.6. For the assembly of robots it is not allowed to use other materials, such as adhesives, tapes, screws, etc.

7.7. The red LEGO Mindstorms – Part Number 41250 (diameter 52mm) balls will be used as football balls.

7.8. The robots will not be autonomous, but will be controlled remotely. The operation is carried out via the smarthub's connection to **Scratch**. Alternatively, a fully programmable remote control can be used in cooperation with the Microbit **board**, which gives full control of the player. Microbit is connected to the controller and then Microbit is connected to Mind+ to control WeDo

7.9. It is possible to make pre-programmed moves in the program.

7.10. Each robot should fit upright inside a 15 cm cube.

7.11. The dimensions of robots are measured when they are upright and have all their movable parts fully open.

7.12. Wires are counted in measuring dimensions .

8. Assembling Robots

8.1. The robots should be ready when you enter the competition.

8.2. Competing students should not use any kind of help, such as instructions or drawings on paper, photos stored on the computer, etc.

8.3. Competing students are allowed to use programs they have written earlier (before the day of the competition).

8.4. Students are allowed to modify their constructions or programs from the time they enter the competition area or in the space between races. That is, there will be no quarantine before or during the games.

8.5. It is the responsibility of the teams that their robots constantly meet all the specifications and restrictions set by the rules. If, after a race, a robot is found to be in breach of a rule, then the points earned in that race will be deducted from the alliance.

9. Ball Control

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

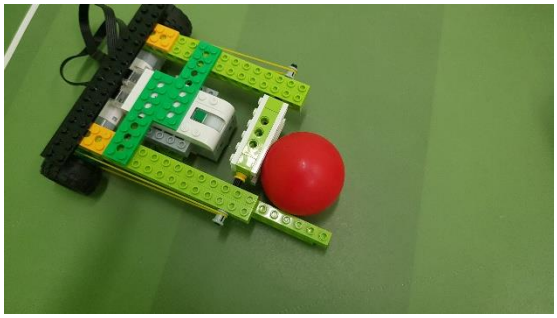
9.2. The ball is not allowed to penetrate more than 2cm into any "Ball Capture Zone".

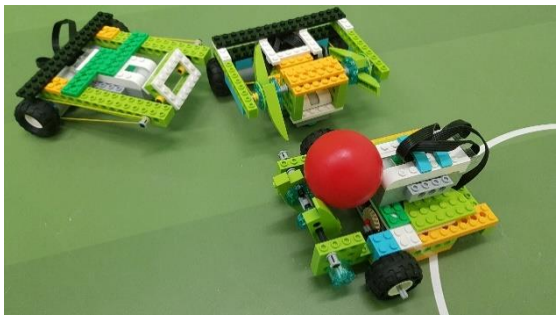
9.3. A robot is not allowed to hold the ball. This means that it should not take away any of its degrees of freedom. For example, the ball cannot be fixed to the robot in any way, the ball cannot be encircled by the robot, nor trapped by any part of it (e.g. on it). If the ball stops rolling and starts crawling while the robot is still pushing it, or if

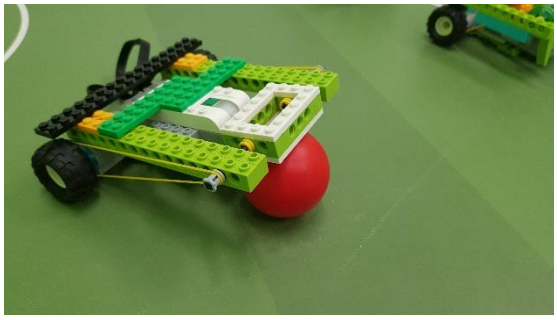
the ball is not reflected as it hits the robot, these are signs that the robot is holding the ball.

9.4. The ball cannot be under a robot. More specifically, no part of the robot can protrude above the ball more than half its diameter.

9.5. In case a robot captures the ball, the referee places it in the center, without stopping time from ticking.







Figures 11, 12 & 13 *Cases when the ball is "captured by the robot"*

THE BALL IS PLACED IN THE CENTER	THE BALL KEEPS ROLLING, NO INTERVENTION
When the ball crosses the entire end line parallel to the goalposts (5.8)	When the ball crosses the side lines of the field with the inclined plane
When the race starts (5,1)	
When goals are scored (5,3)	
When "pushing" an opponent is imputed (5,5)	When a "double defence" is charged by the referee inside the area
When the ball gets stuck between two robots	When two robots stick together and the referee unblocks them
When a robot captures the ball (9.5)	

THE ROBOT IS PLACED IN THE CENTER	THE ROBOT IS PLACED IN THE CORNER
When robots do "double defense" (5,10)	When the robot makes "deliberate pushing" (5,6)
	When the robot deliberately stays in front of its goal stationary or moves parallel to the goal line for more than 3 seconds (5.11)
	When a robot that was classified as damaged returns to the game (6,2)

10. Tournament procedure

10.1. The tournament will be held in two phases: the preliminary and the final.

10.2. The qualifying phase will take place in 4 rounds. In each competitive round of this phase, alliances will be formed by random draws.

10.3. In each game the teams of the winning alliance will share 3 points each. In games that end in a draw, all teams will be shared by 1 point.

10.4. In the qualifying phase, teams are ranked on a single leaderboard.

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

- Goal difference
- Total number of goals scored
- Total number of goals conceded
- Highest number of goals scored in a game
- Draw

10.6. The top 16 teams of the qualifying phase qualify for the final phase.

10.7. The alliances of the final phase are stable until the end of the tournament and arise as follows: The 1st team is allied with the 16th, the 2nd with the 15th, the 3rd with the 14th and so on.

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

10.9. In case a knockout match ends in a draw, the teams go to 4 minutes extra time, where the **golden goal** applies (whichever alliance scores first during extra time wins the match).

10.10. If no goal is scored during extra time, then the game goes to the penalty shootout. Each alliance will shoot 4 penalties alternately (from 2 each robot mandatory) as follows: The ball is set up by the referee in the white dot of the center and each robot takes charge and heads towards the ball, to shoot at an empty goal. The wheels of

the robot are not allowed to touch or cross the center line. Therefore, gamers should hit the brakes in time. Otherwise their penalty will be cancelled and will not be repeated.

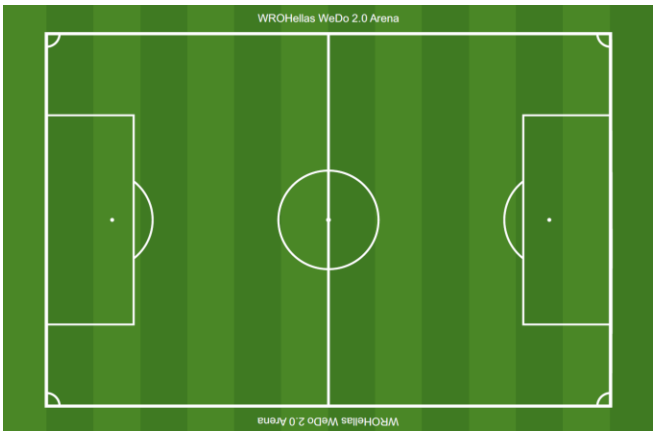
10.11. All robots shoot at the same goal, which is selected from the 2 alliances. If they do not agree, the referee draws lots.

10.12. The teams of the alliance that will win the tournament share the 1st place.

10.13. In the event of a team leaving, the game is played normally with the alliance competing with only one robot. The opposing alliance normally competes with its two teams.

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

11. Football



11.1. The floor will be printed on canvas from a high-resolution file that you will find on the Stem education website (link).

11.2. The tarpaulin has dimensions: **2100 X 1318 mm**

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

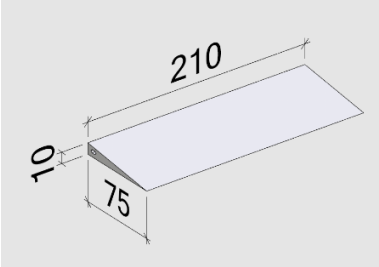
11.4. Large Area Dimensions: **287 X 645 mm**

11.5. The hobs will have the following dimensions:

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

11.6. To improve the quality of play, ramps measuring **75mm x 10mm** (e.g. 10 pieces x 210mm length each) can be placed on the long sides of the pitch. The purpose of inclined planes is not to let the ball stick to the side walls of the field, but to push it

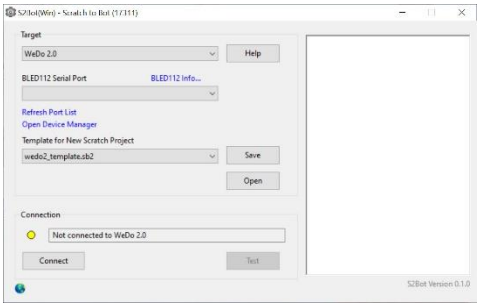
towards the center. The height of the ramps can vary from pitch to pitch depending on the material to be used as a carpet. Ideally, when the ball is released from the top of the inclined plane, it should stop in the center of the field.



F. Appendix: smarthub connection examples

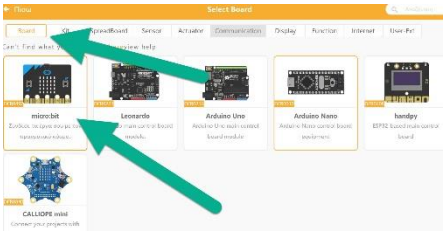
A WAY

The smarthub connects to **s2bot for scratch** with the gray gear and software Scratch 2 version 4.5.3. BlueGiga's Bluetooth v.4.0 USB dongle required



B WAY

With microbit and supported remote control controlled by mind+ software. Its own scratch link is required.



C MODE

S2Bot App for Windows (MSI)

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

Prerequisite steps ONLY for the first time:

1. Buy BlueGiga's Bluetooth v.4.0 USB dongle (hereinafter named "BLED" - see what it looks like in the following 2 photos:

2. For Windows 10 PCs, by inserting BLED into a USB port, Windows 10 automatically recognizes it.
3. Now we will have to install the program that plays the role of intermediary between BLED and Scratch 2.0 (for Scratch see next step 4). We call our favorite web browser, enter at:

http://www.picaxe.com/Teaching/Other-Software/Scratch-Helper-Apps,

We scroll down the website until about halfway through and find the report:

"S2Bot App for Windows (MSI)" and click on it to download it. After we run and install it completely, the application icon - '  ' will also appear.

4. Before installing MIT Scratch 2.0 version 453 (be careful – only this version works properly), you will need to install Adobe AIR. You will find both executable files in the same directory as the current help file you are now reading. If later, when the Scratch 2.0 application opens, it suggests that you upgrade it to the newest version, NEVER accept it!

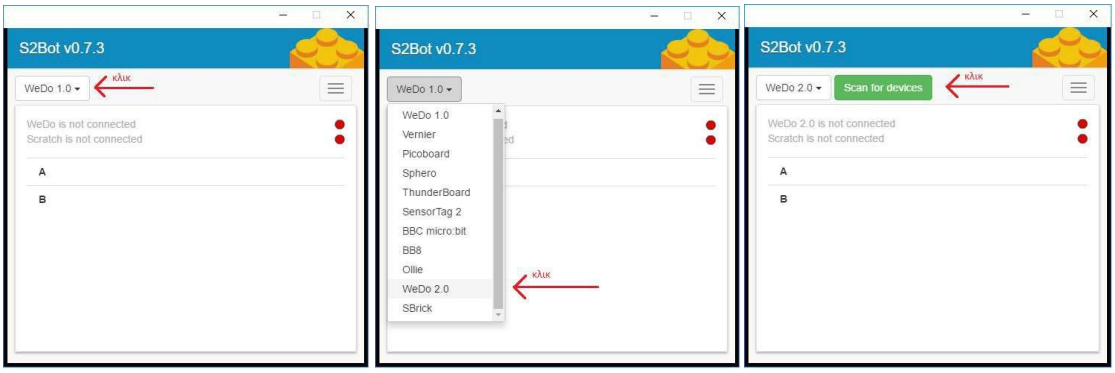
This is where the prerequisite actions of the first time end. We won't have to run them again.

The steps we will perform EVERY time we want to operate WeDo

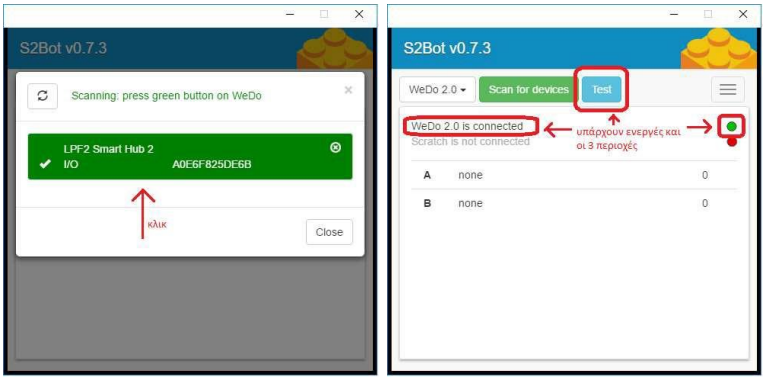
2.0 from Scratch 2.0

1 We call the application "S2Bot for Scratch" by its abbreviation (it is advisable to "pin" it to the taskbar beforehand).

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



3 We press it and the message "Scanning: press green button on WeDo" appears. We press the green button on the Hub and once the Hub is detected in the app, we select it. In a few seconds the option locks! If it is not detected, we close the application, remove the BLED from the USB port and try the steps again – see the following 2 photos:



4 Call Scratch 2.0 and open (File–open option) the file "wedo2_x1_template.sb2" that you will find on the internet. Then we select from the menu. of Scratch 2.0 the option "More Blocks" and in front of us appear all the commands related to the operation of WeDo 2.0 – see the photos below: