Module 1

ROBOTICS THROUGH SIGN LANGUAGE: ENSURING ACCESS AND ENGAGEMENT OF STUDENTS WITH DISABILITIES (DEAF OR WITH HEARING IMPAIRMENT) TO THE DIGITAL WORLD OF CODING AND ROBOTICS – ROBOTICS4DEAF

Project no: 2019-1-PL01-KA201-065123

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Version: 01.2020

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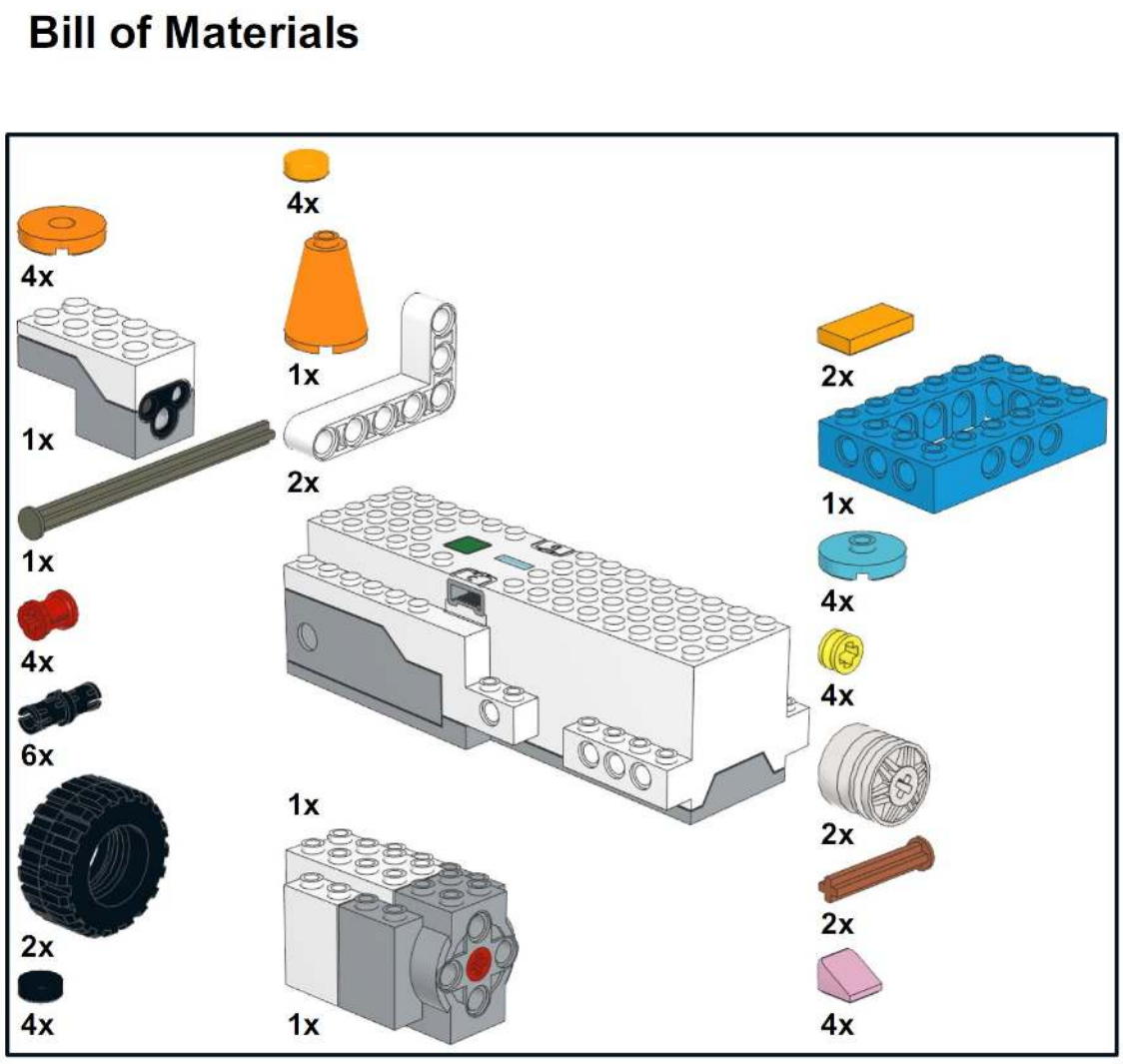
1. SMARC – SMArt Robotic and Coding

The aim of this section is to introduce students to the basic movements of robots. Students will build the robot SMARC and learn to program it to perform basic movements. They will also learn how to use loops to program it to make repetitive movements.

I. Build SMARC



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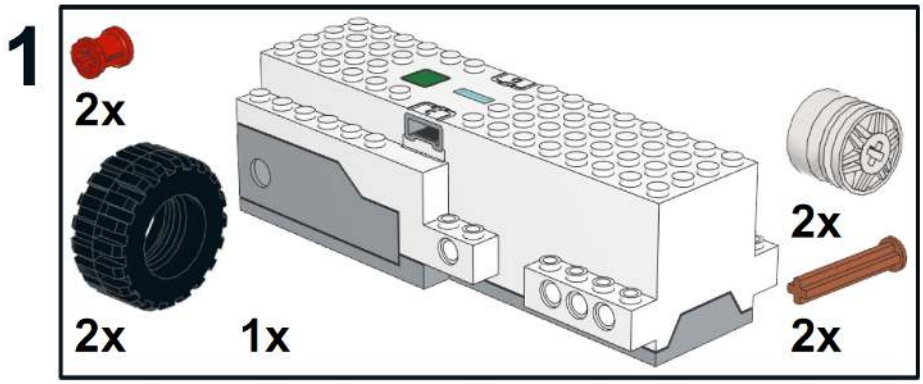

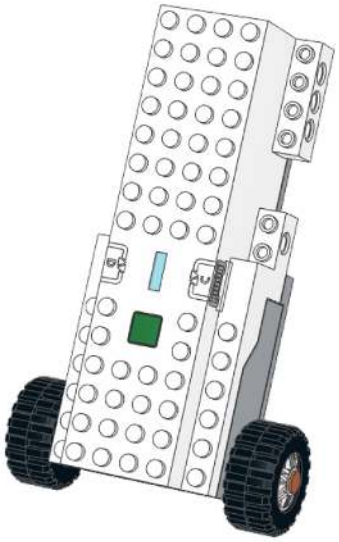

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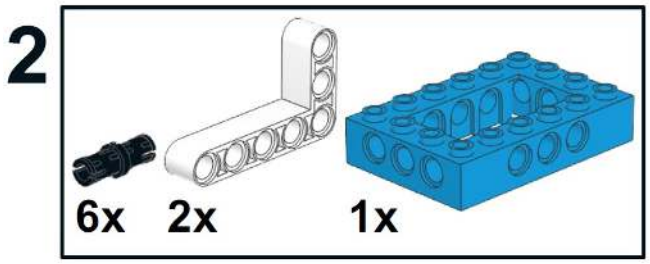

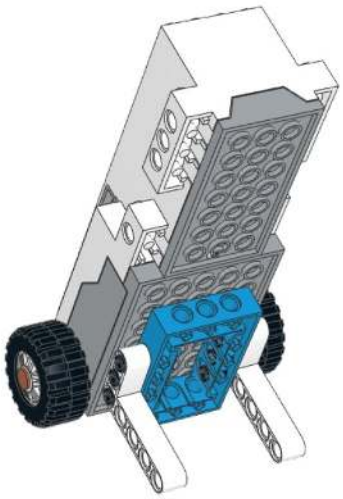

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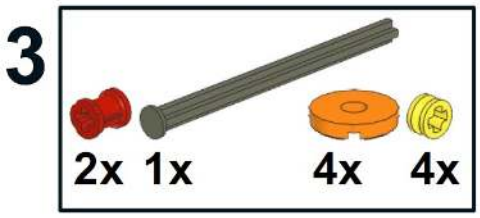

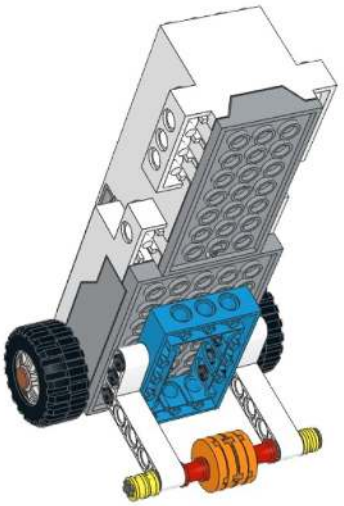

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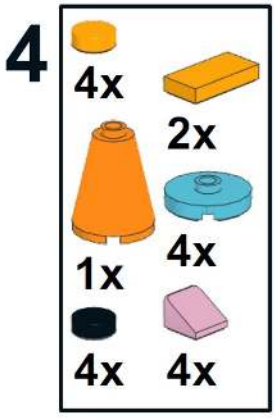

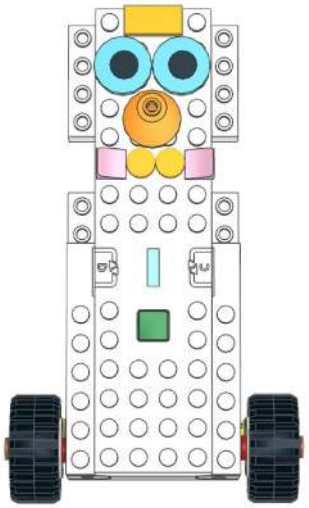

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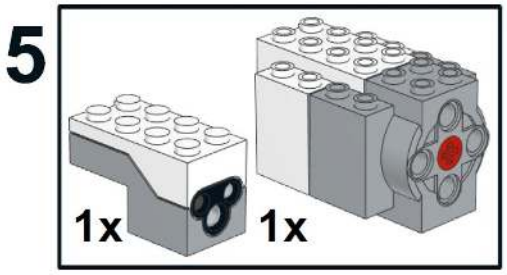

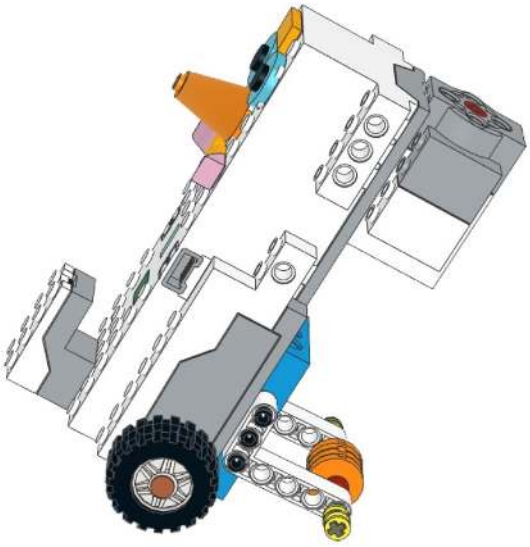

II. Learn how to make SMARC move.

The photo below shows the programming environment of the application.

It also shows the area where the programming blocks are located. There you will find everything you need to make your own programs

Spend some time to browse the application.

https://www.youtube.com/watch?v=MwRDmAlIGXQ

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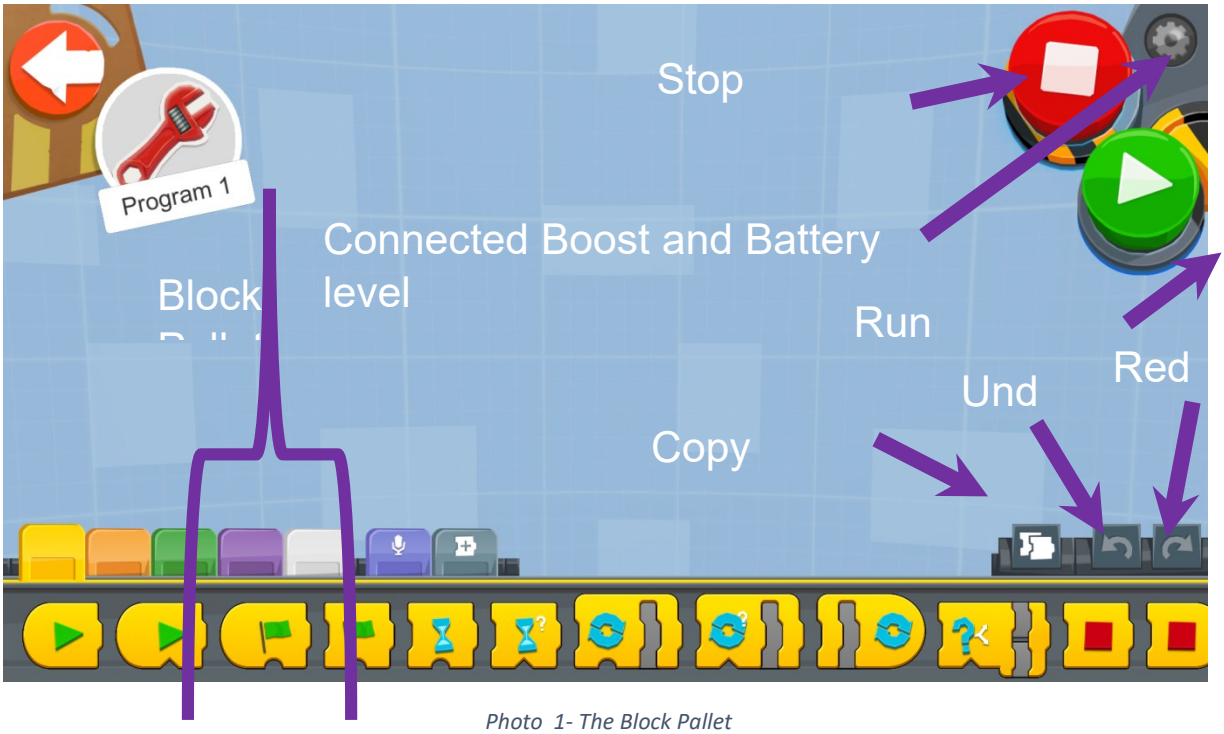

Photo 1- The Block Pallet

A. Grouping the blocks.

In this section you will learn how blocks are grouped according to their color. Knowing the general categories makes it easier to find the right block depending on what we want to do. In the following sections we will examine each category in detail.

https://www.youtube.com/watch?v=mByDBP3O4mk

- With **Yellow** blocks you can control the flow of the program

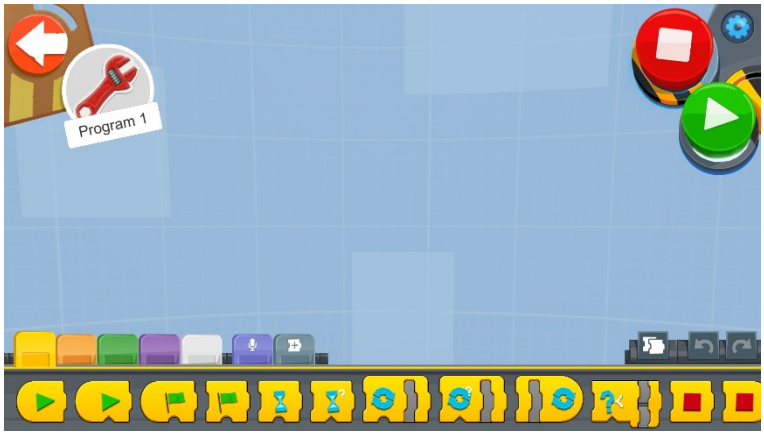

Photo 2-Yellow Blocks

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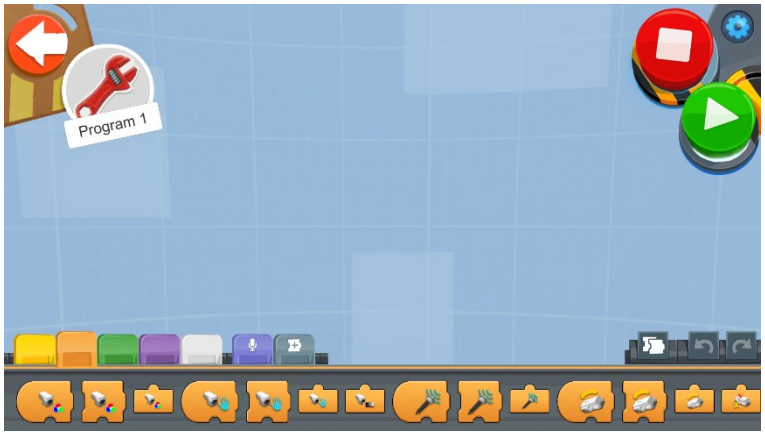
You can use them to start a program, stop a program, pause a program or even loop a group of commands

- The **Orange** blocks work with the Color and Distance Sensor, microphone and the Move Hub's Tilt Sensor



When one of the above sensors is activated, it will also activate those blocks.

- **Purple** blocks are used for communication of the robot with the outside world.

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They can play sounds through the user's device speakers. They can also change the color of the lights on the Move Hub & Color and Distance Sensor.

- **White** blocks let you do some complex programming using 'variables' and 'constants'

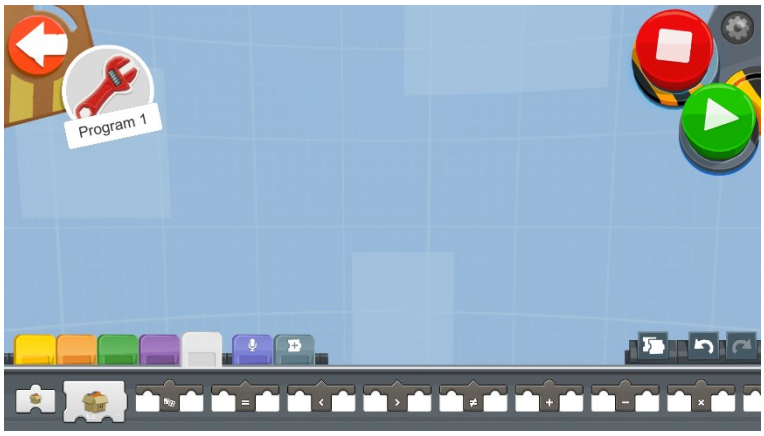

Photo -White Blocks

They can also be used when performing various mathematical calculations, creating logic expressions and generating random numbers

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- **Light Purple** blocks let you record a sound for the robot to repeat.

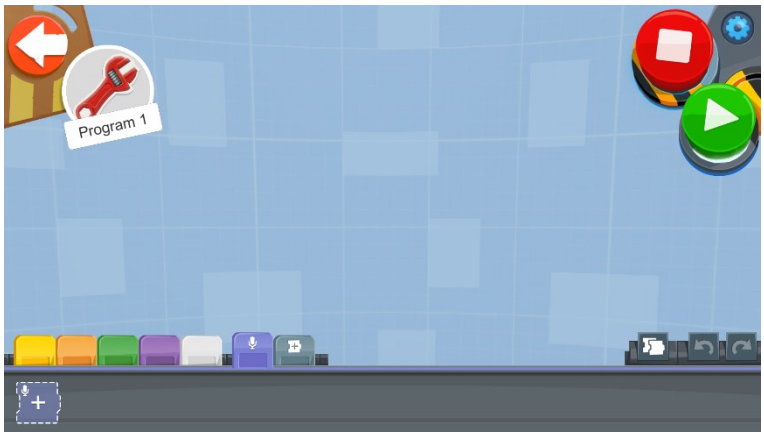

Photo -Light Purple Blocks

- **Group Actions** block let you group as one block button several actions

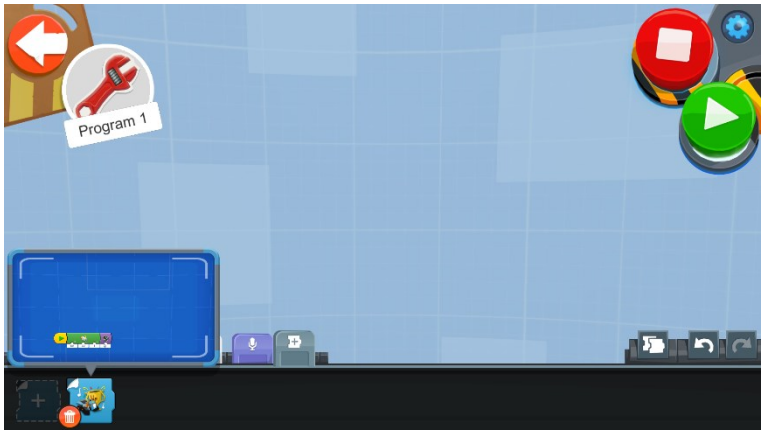

Photo - Group Action Blocks

This is the equivalent of creating sub-programs

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B. How to make SMARC move

In order to begin coding SMARC the first thing we need is the Start Block located in the Yellow Pallet

https://www.youtube.com/watch?v=Sdv190liSJc

There is a number of blocks, which control the movement of the Move Hub. Those blocks can be found in the Green Section of the Pallet. Here we present the most common ones.

https://www.youtube.com/watch?v=UjusigZPIr0

Move Base for Duration - Motor one speed (from -100 to 100) and Motor two speed (from -100 to 100) for duration (in seconds)

Move Base Tank for Distance - Motor one speed (from -100 to 100) and Motor two speed (from -100 to 100) for distance (in degrees)

Move Tank and Steer for Duration - Both motors speed (from -100 to 100) and steering direction (from -100 to 100) for duration (in seconds)

Move Tank and Steer for Distance - Both motors speed (from -100 to 100) and steering direction (from -100 to 100) for distance (in degrees)

Move Tank - Motor one speed (from -100 to 100) and Motor two speed (from -100 to 100)

Move Tank and Steer for Duration - Both motors speed (from -100 to 100) and steering direction (from -100 to 100)

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C. Sample Programs

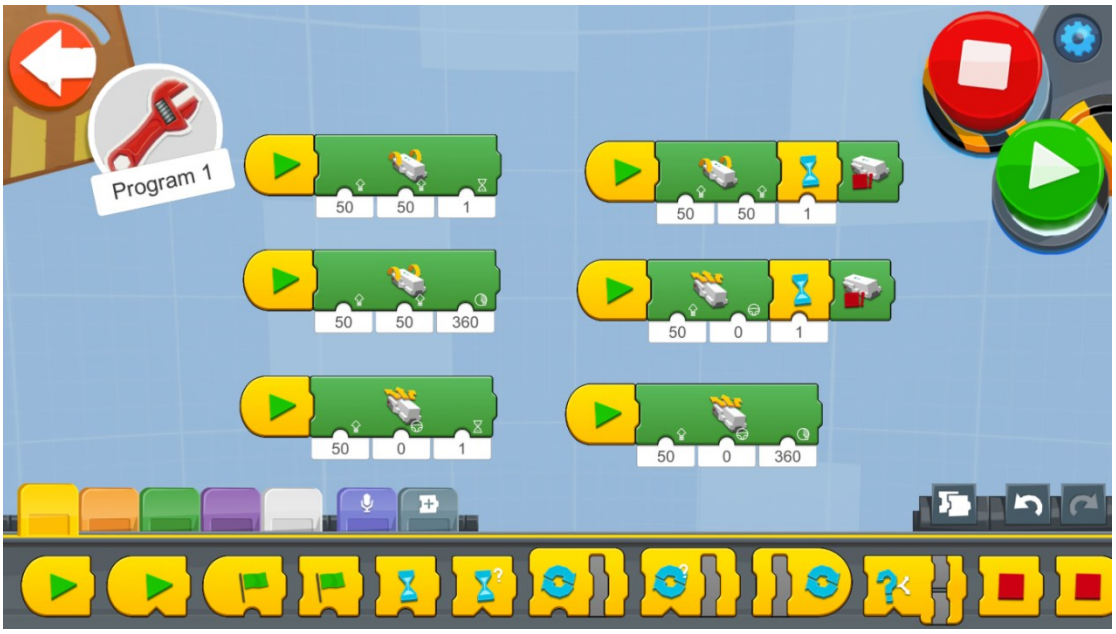

Photo 8 – Make SMARC move

Try using the different blocks for moving like the example program above.

Video with the following text and Smarc executing the programs.

Create a new project on the Creative Canva and run each block of code and notice the differences and similarities.

Note that the moving blocks which do not set the time interval or the amount of degrees (rotations) of the movement will continue to turn the motors intefinetly unless a wait block is added which sets the time interval for the motors to work followed by the stop motors block.

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Learn how to make Smarc move. - https://youtu.be/-Jor9F0y4fA

Note: if the learner has completed the first activity with the simple car oe the first of Vernies series, can use a more simplified version of the movement blocks.

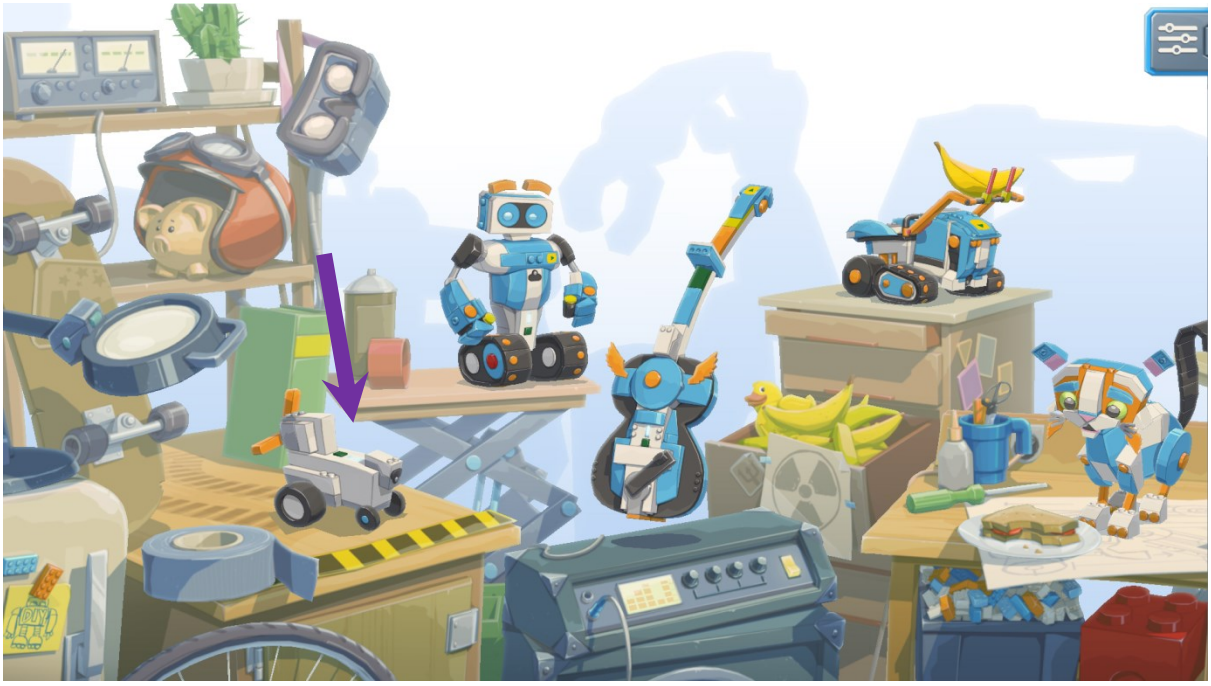

Photo 9-The Main Lobby Scene of Lego Boost App

Step 1: Go to Simple Car Icon on the Main Lobby Scene and click it

Photo 10-The Simple Car Activity 1

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Step 2: Click on the First Activity

HINT for the teacher: You can unlock the programs by pressing the activity you want to unlock for five seconds.

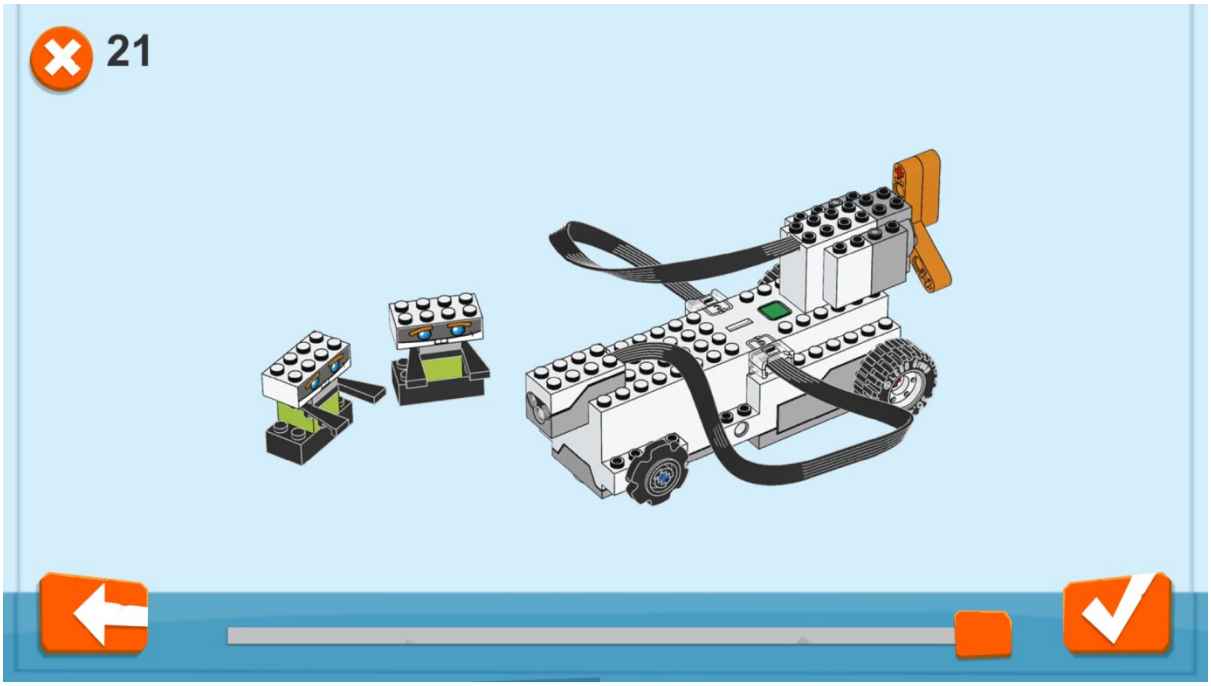

Photo 11-Building the Simple car

Step 3: If it is the first time opening this specific activity the step by step guide for building the car showed. You can always just scroll to the last page and click on the tick icon.

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Photo 12-The Basic blocks for simple movements

Step 4: Use the simple move blocks to move Smarc. How far does he move when one straight arrow block is used? Does it move in the expected direction?

Note for the teacher: The driving motors for Smarc are in the front of the robot, on the Simple Drive Car they are situated in the back of the robot.

III. The loop coding concept

Loops allow Smarc to easily repeat blocks of code without having to put blocks of code again and again. There are different types of loops in coding.

"For Loops" let programmers repeat code a specific number of times.

"While Loops" require a condition to be true in order to repeat code.

"Forever Loops" repeat code forever and should be avoided when not necessary because they can consume all the resources of our computer and run out the batteries of our robot.

https://www.youtube.com/watch?v=kAUcAlgB-XA

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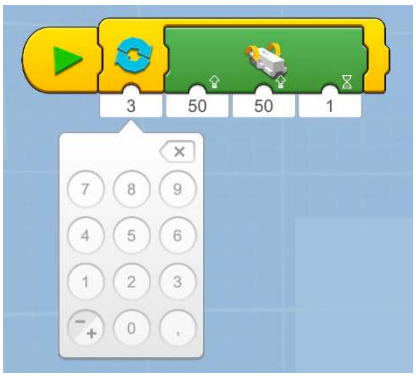
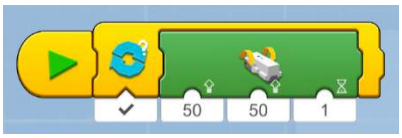
- “For Loops”.
  The Loop For Count: Loops the enclosed blocks of code for a specific number of times which can be set by the user

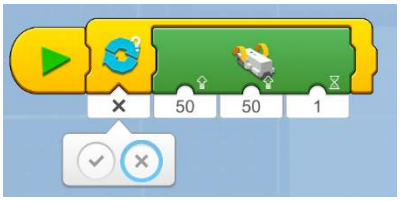


Video

- “While Loops”
  The Loop While True: Loops the enclosed blocks of code while contition is true.

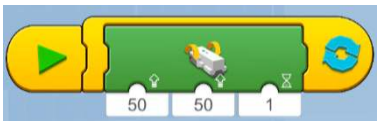


  The user can set if the loop will be executed if the condition is true or false.



Video

- “Forever Loops”
  The Loop Forever: Loops the enclosed blocks of code



loop coding concept - https://youtu.be/hPyylPF2QZM

Sample Programs of Loop Blocks

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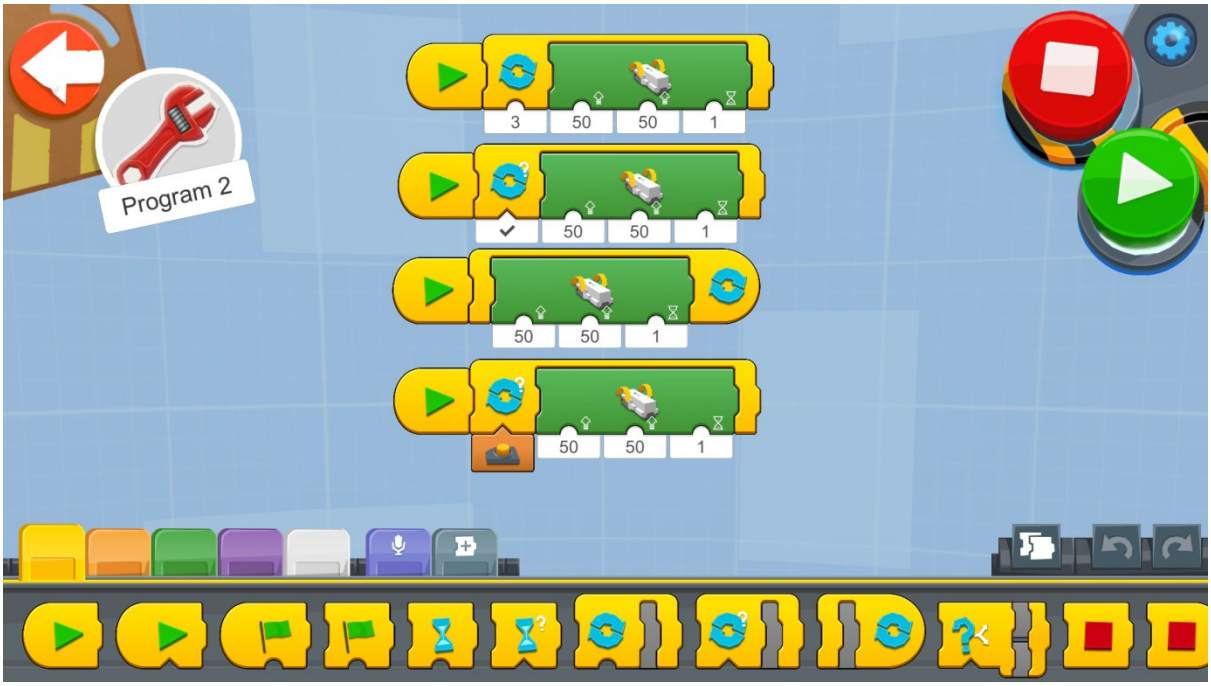

Photo 13-Program - Loop blocks

Try using the different blocks for Looping commands like the example program above.

Create a new project on the Creative Canva and run each block of code and notice the differences and similarities.

Notice that the last block of code is not working properly. Try and make it work so when a button is pressed the Loop is activated (the loop condition becomes true).

loop sample programs - https://youtu.be/PcGk9zD2M5k

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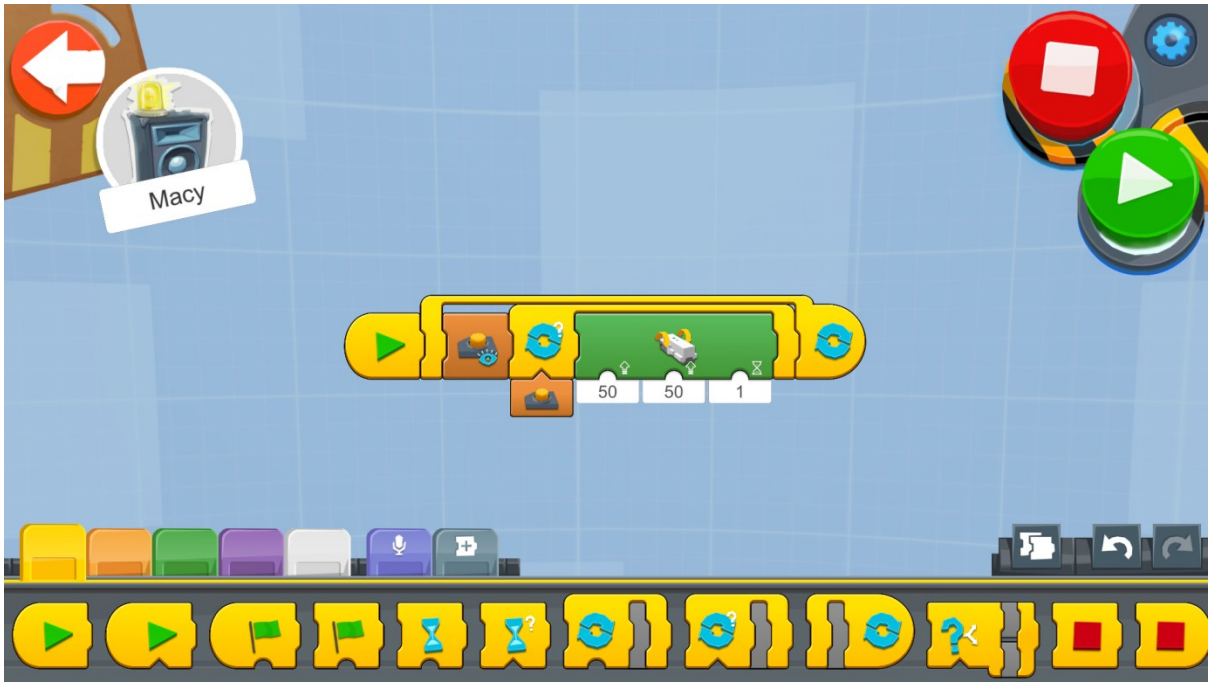

Photo 14-Program - Nested Loop

The solution is to insert another Loop Forever loop and add the button appearance block outside the Loop While True block. This is called a nested loop (a loop inside a loop).

2. Using Sensors with Smarc

IV. Sensors

In this section, we will see how we can incorporate a sensor to Smarc and how we can utilise this sensor in order to detect obstacles, various colors, the intensity of light as well as the distance from an object.

A. The Lego Boost Color and Distance Sensor

A sensor is a device, which detects events or changes in the surrounding environment and sends the information to a computing device in order for it to process it and take actions. There are many examples of sensor usage in our everyday life. From a motion sensor, which detects movement and turns on the lights or opens a sliding door to temperature sensors, which detect the temperature and switch on heaters and air conditions. Sensors are also used in most types of remote-controlled devices such as Televisions and Air Conditions.

https://www.youtube.com/watch?v=Wc6kaqE3wow

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The LEGO BOOST Color and Distance sensor as shown in Figure is used for:

- Sensing distance - How far an object-obstacle is situated from the sensor.
- Sensing color - it can detect specific colors (Black, Blue, Green, Yellow, Red, White) as well as the absence of a color.
- Detecting movement - it can be used as a motion detector
- Detecting light - It can detect the light level reflected on the sensor measuring from 0 - darkest to 10 - lightest.

Additionally, the Color and Distance sensor can emit different colors (Red, Green, Blue, and a combination of the three).

B. Detecting Objects

The Detecting Objects Blocks

Trigger on Distance Block - Triggers when the distance determined by the sensor is less than the distance indicated by the value below it. When it is triggered, it executes the following code sequence. Values from 0 to 10 can be taken.

Sensor Distance Reporter - Displays the current distance determined by the sensor in real time. It must be connected to the bottom of the other blocks in order to be included in the software. Values from 0 to 10 can be taken.

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Wait for Distance - Waits for the distance determined by the sensor to be less than the distance indicated by the value below it. If the object is not closer than the stated value, the program will remain paused and the program will begin to follow the following sequence of instructions until the condition is met. Values from 0 to 10 can be taken.

Sample Programs of Detecting Obstacles

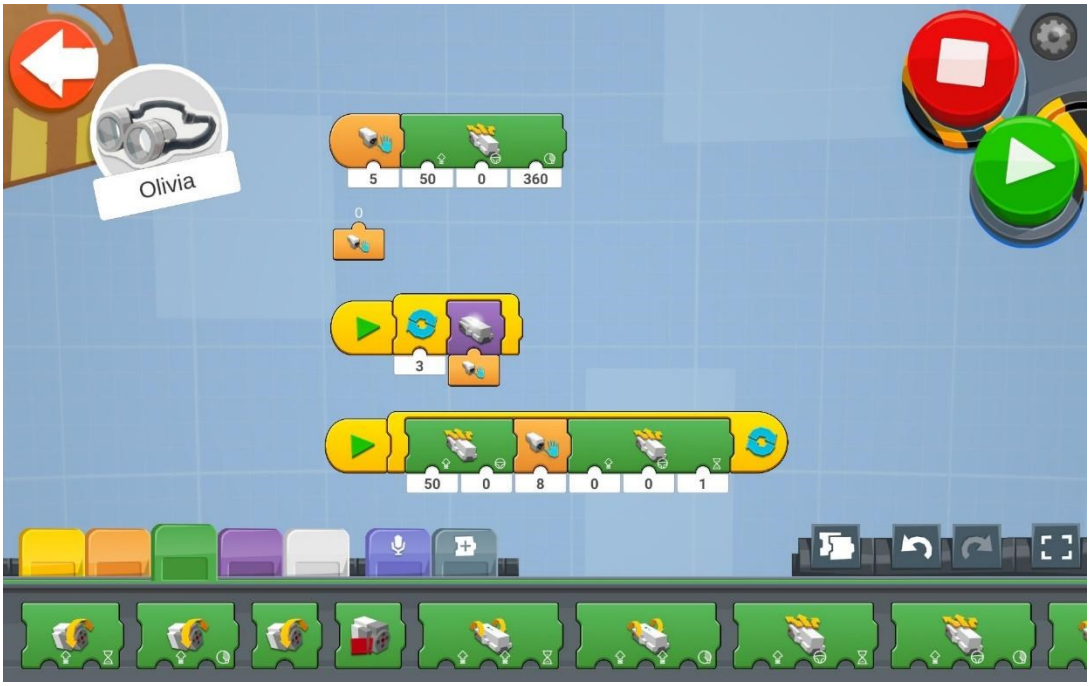

Photo 15-Detecting Obstacles

1. The first program activates when an object is less than distance 5 in front of Smarc. Smarc will then move 360 degrees forward at speed 50.
2. The second block just indicates in real time the distance from an object in front of the sensor.
3. The third program takes the distance and uses it as an input for selecting and showing colors on the movehub lamp. Notice that when the distance from an object changes the color also changes.

In the fourth program Smarc starts moving at speed 5 forward and when it detects an object in distance less than 8 it stops for a second, then tries to move again.

detecting obstacles - https://youtu.be/CAXnOmMiUDQ

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C. Detecting Colors

The LEGO BOOST sensor can detect six colors (Black, Blue, Green, Yellow, Red, White, and the absence of color - no color, which means no object is being detected by the sensor).

https://www.youtube.com/watch?v=f2nJZYSGHdo

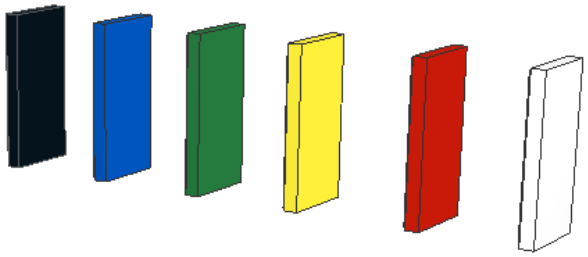

Photo 16-The Colors, which the Sensor can see: Black, Blue, Green, Yellow, Red, White

Notes:

If an object is not in the proposed range of the sensor, the color might not be detected correctly. For example, a green object might be detected as blue.

Also, if the color of the object is not one of the six detectable colors the application will present it as the closest color possible. For example, orange will be presented as red.

https://www.youtube.com/watch?v=_8Q9QR87nI0

The Detecting Colors Blocks:

Trigger on Color - Triggers when the color measured by the sensor is equal to the color shown by the value below it. When activated, the following code sequence is executed. Seven values can be used: No color, Black, Blue , Green , Yellow, Red and White.

Wait for Color - Waits for the color determined by the sensor to be equal to the color shown by the value below it. If the color detected is not equal to the value specified, the program will remain paused and the following sequence of instructions will begin until the condition is met. Seven values can be used: No color, Black, Blue , Green , Yellow, Red and White.

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Sensor Color Reporter - Shows the current color measured by the sensor in real time. In order to be used in a program, it must be located on the bottom of the other bricks. You will see seven values: No color, Black, Blue , Green, Purple, Red and White.

Sample Programs of Detecting Colors

We will first need to install the interactive motor before we see the detecting colors programs.

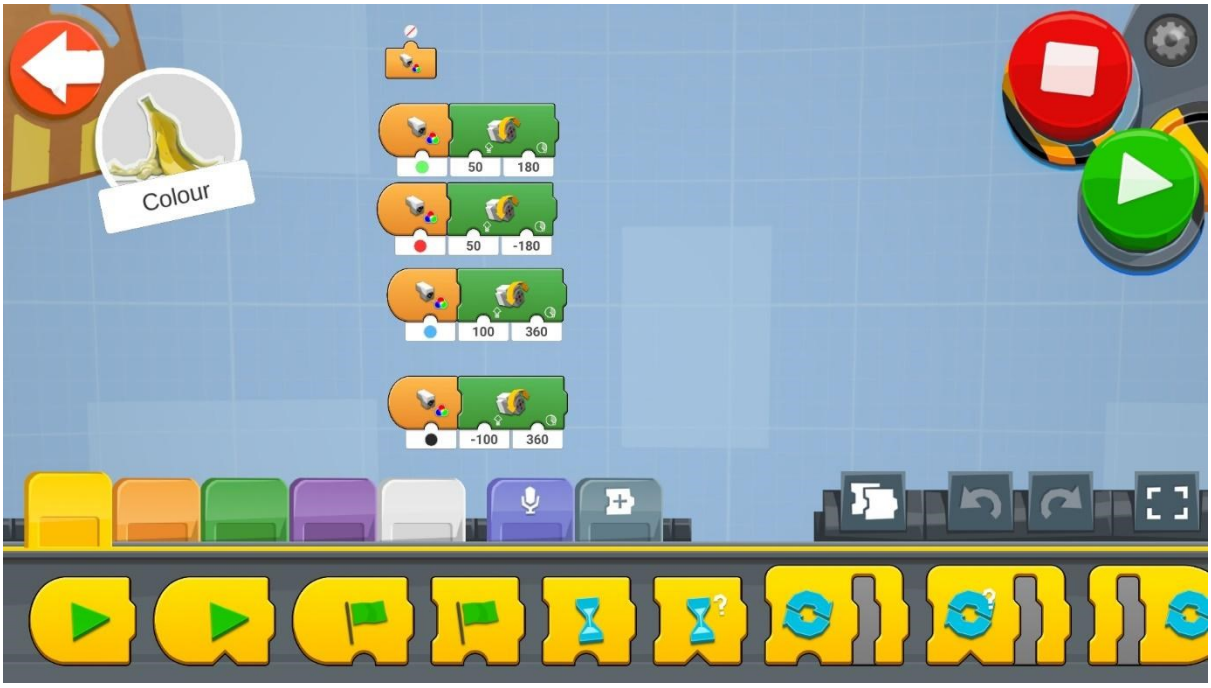

Photo 17- Program - Detecting Colors

1. The first block just indicates in real time the color of the object in front of the sensor.
2. The second program activates when an object of green color is in front of Smarc's sensor. Smarc will then move the propeler 180 degrees to the right at speed 50.
3. The third program activates when an object of red color is in front of Smarc's sensor. Smarc will then move the back propeler 180 degrees to the left at speed 50.
4. The fourth program activates when an object of blue color is in front of Smarc's sensor. Smarc will then move the back propeler 360 degrees to the right at speed 100.
5. The fifth program activates when an object of green black is in front of Smarc's sensor. Smarc will then move the back propeler 360 degrees to the left at speed 100.

detecting colors - https://youtu.be/onDfjAmNHio

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D. The If/Else Blocks:

The If/Else statement allows Smarc to easily make decisions based on the inputs from the sensor. If a condition is met (meaning it is TRUE), Smarc will execute a specific block of code. Else if the condition is not met (meaning it is FALSE), Smarc will execute another block of code.

https://www.youtube.com/watch?v=NB4jivbIhqc

If/Else - If a condition is True then execute the top sequence, else if it is False, execute the bottom sequence.

Equal Operator - Returns True when an input from a sensor (color/distance/ambient light) is equal to a value.

Less Than Operator - Returns True when an input from a sensor (color/distance/ambient light) is less than a value.

Greater Than Operator - Returns True when an input from a sensor (color/distance/ambient light) is greater than a value.

Not Equal Operator - Returns True when an input from a sensor (color/distance/ambient light) is not equal to a value.

Measuring the Amount of Light Reflection: The Measuring Light Reflection Blocks:

Sensor Light Level Reporter – Displays in real time the current ambient light level measured by the sensor. In order to be used in a program it needs to be attached to the bottom of other blocks. It can indicate values from one (1) to ten (10). One being the darkest and ten being the brightest.

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V. Following Walls with Smarc

A. Following Walls

In this section we will see how Smarc can travel in an area by following one side of a wall or one side of an object.

These programs, which react from "inputs" taken from their surrounding environment, are called "Feedback Control" systems. They are called like this because through sensors they monitor changes or situations and respond with changes – "output" in the system, and in our case the system is our robot - Smarc.

https://www.youtube.com/watch?v=0kzYObgjX-k

Building the Sensor

In order to have Smarc travelling at a constant distance from the wall, the input, which will be used, is the reading from the distance sensor. The output will be the motors of Smarc, which will adjust the driving direction.

The first thing we will have to do will be to attach an extension in the front part of Smarc where we will place the color and distance sensor.

https://www.youtube.com/watch?v=Mz2NY3VTFZU

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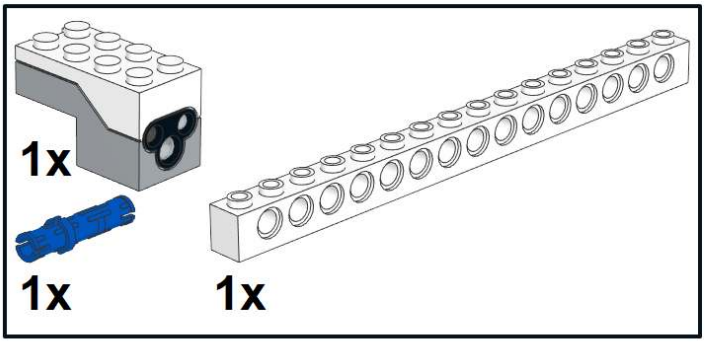

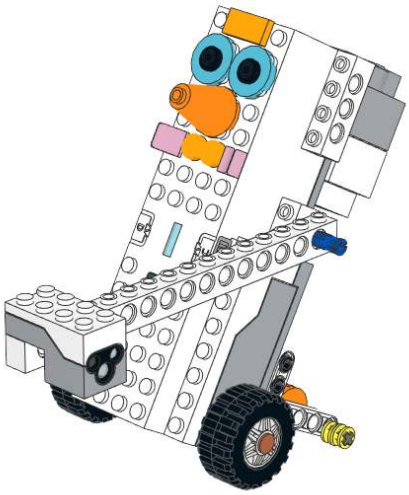

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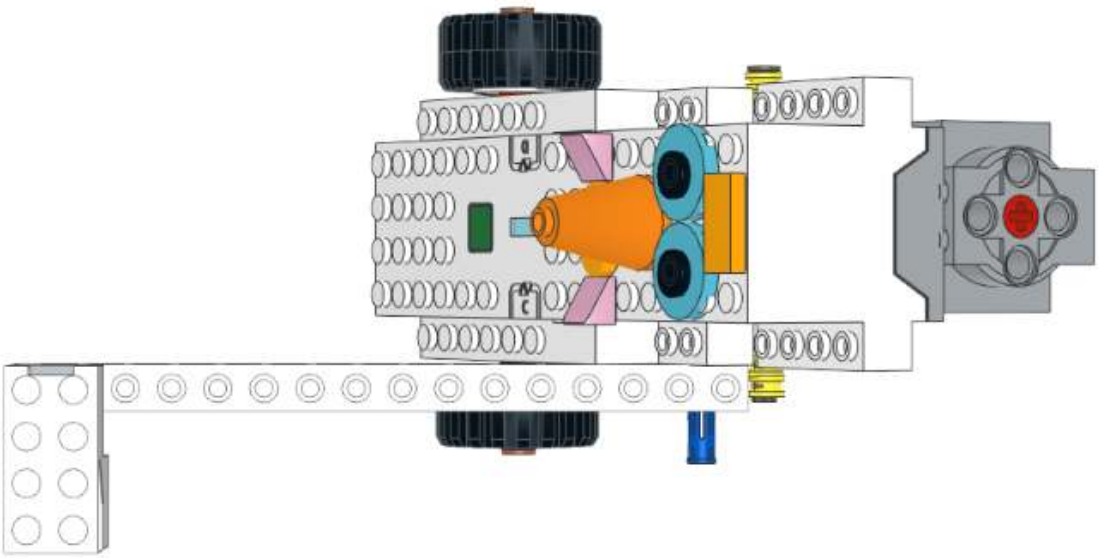

After we have prepared Smarc with the distance sensor, we will then need to create a track with walls where Smarc will be moving in.

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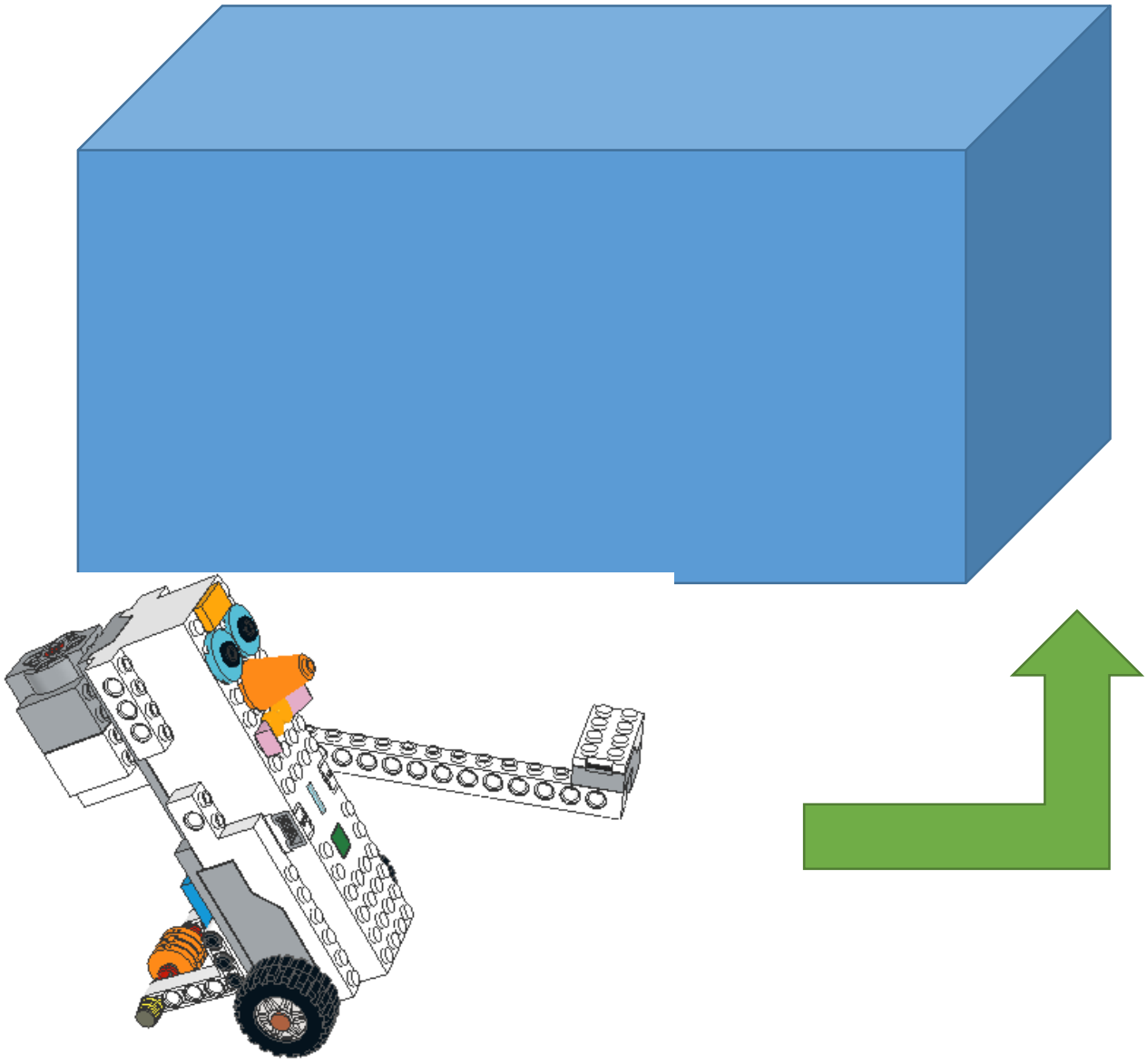

When making a track, keep in mind that the exact side of the wall that will be tracked will be the direction the sensor is looking. You can use whatever items you find in your classroom to set up a track. It can be boxes or books, but just make sure the surface that the sensor monitors is flat.

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Sample Programs

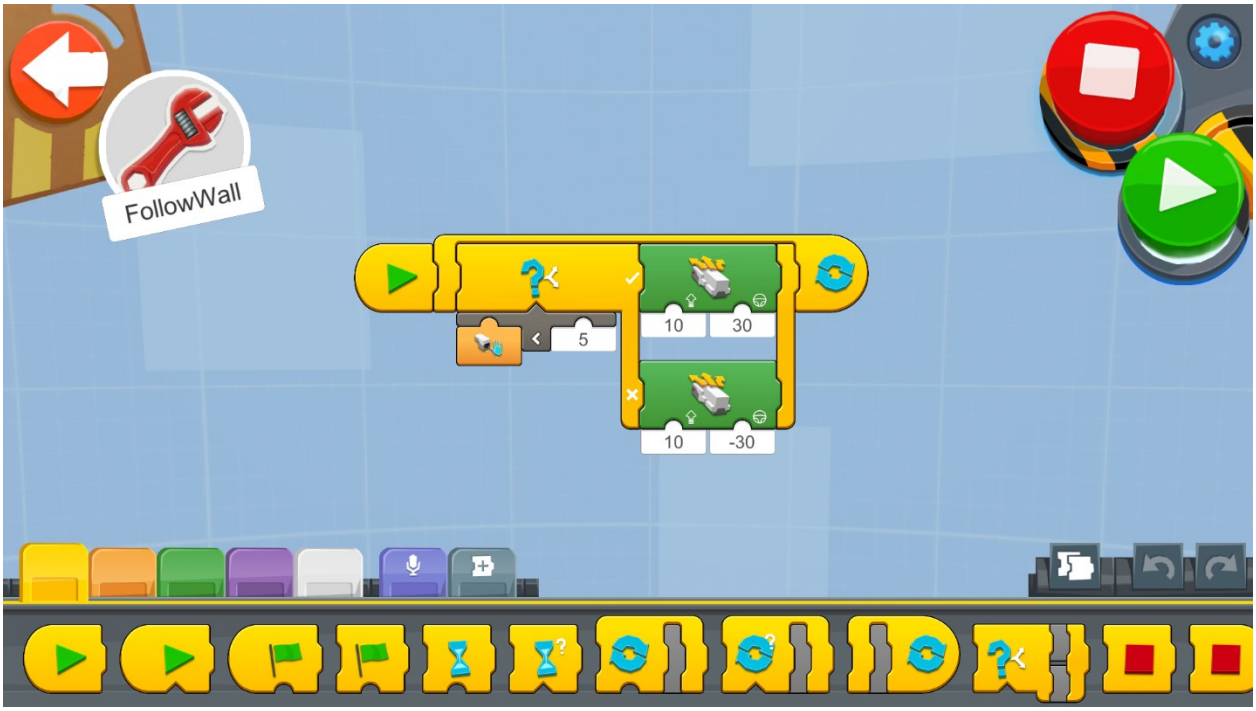

Photo - Avoiding Obstacles

Create a new project on the Creative Canvas and run the block of code (for Android and iOS app you can find the blocks on the Creative Canvas of Vernie).

1. An Infinite Loop will run the code repeatedly so that Smarc checks all the time for an object on its left-hand side and act accordingly.
2. Inside the loop there is an If/Else Block, which compares the input of the sensor, and if the result of the comparison is True it instructs Smarc to move accordingly.
3. Under the If/Else Block there is a Less Than Operator which returns True when an input from a sensor and in this case it's the distance, is less than the value 5 and false if it is equal or greater.
4. If the result of the If/Else condition is True, then Smarc moves 30 degrees towards the right using the Drivebase Move Steering block and if the condition is False then Smarc moves 30 degrees towards the left.

walls - https://youtu.be/YzPEg9krcjA

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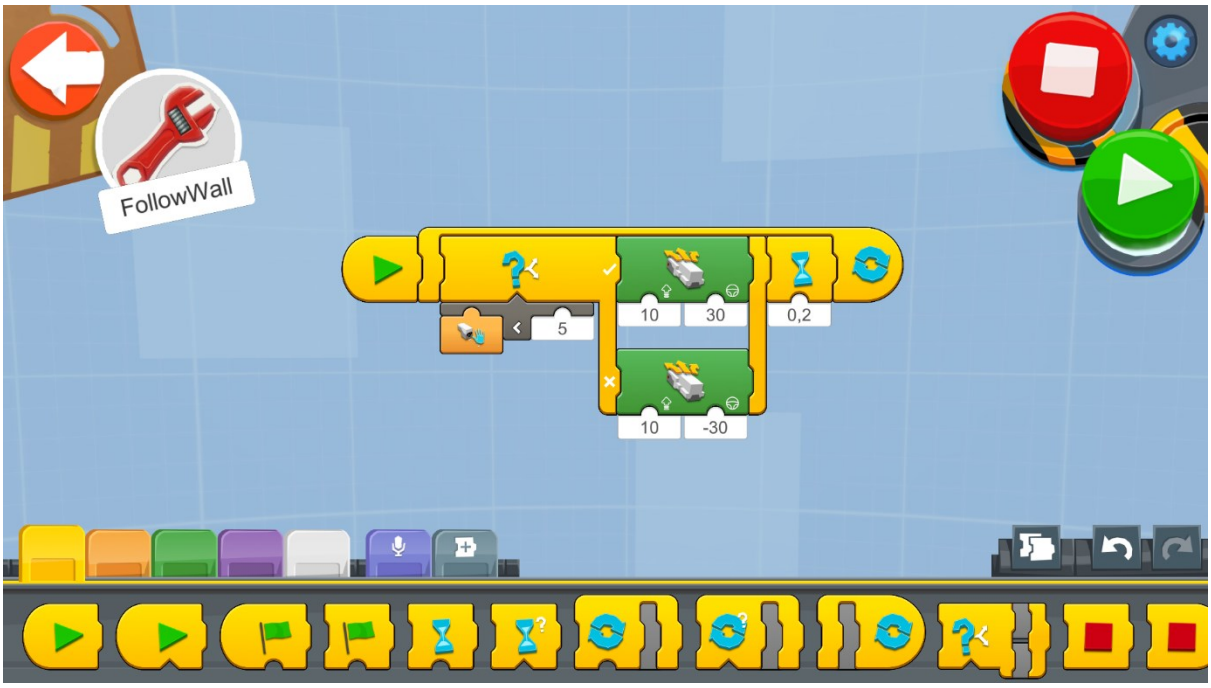

Photo 19-- Avoiding Obstacles

Note to teacher: We can add a Wait for Time block instruction in order to pause the execution by 0.2 seconds in order to slow down how fast the next reading from the sensor gets processed.

This pause will drive the robot for 0.2 seconds before checking the distance from the object. Without a delay of 0.2 seconds, the loop would run at maximum pace, and in some situations the Move Hub would receive commands so much that Smarc would be unable to respond, forcing it to move randomly.

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VI. Following Lines with Smarc

A. Follow the Line

In this section we will see how Smarc can travel in a predifined path marked with a black line on a white background. This task is called line-following and it is one of the most common tasks in robotics. There are also many competitions which include this task and the tracks can vary in complexity, with lines which have sharp turns and intersections!

This type of travelling for robots is also used commercially in many cases. One example can be Amazon warehouses where products have to be collected from different locations and brought together in a box so they can be easily packed and shipped. Lego is also using a similar system when producing new parts in its factory. Line-following robots can either follow a clearly marked line on the floor or they can follow metalic wires which they can detect by using magnetic sensors.

https://www.youtube.com/watch?v=qcdIuvTcHZU

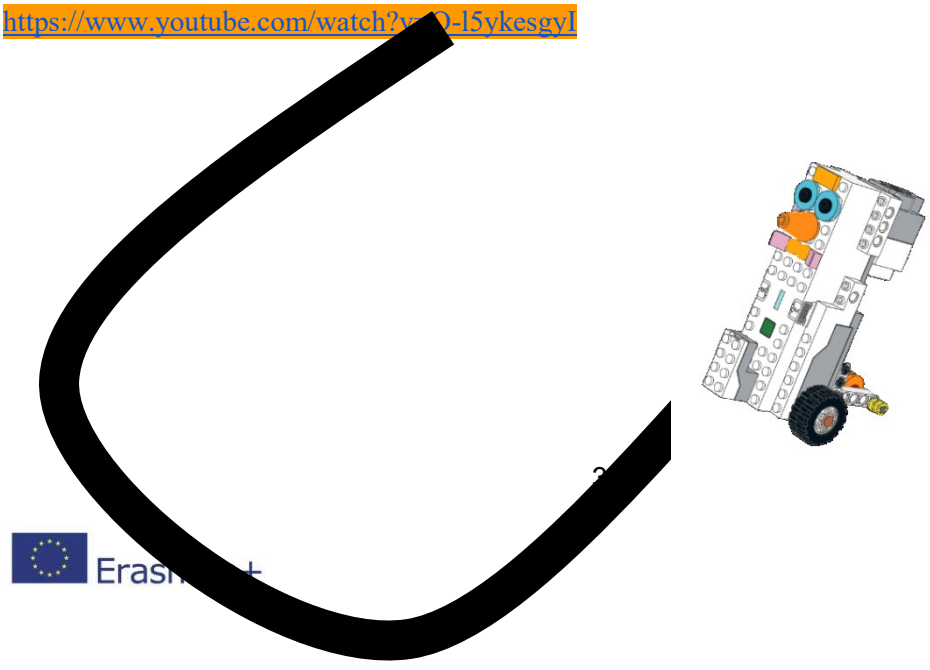
Smarc will be following a line on the ground of a track. In order for this to happen the LEGO BOOST Color and Distance sensor will need to face downwards on the floor. The line and the background have to be colors of high contrast. We can have for example a black line with a white background or a white line with a black background.

The next thing we will need to do is to create a track where Smarc will be moving in.

One simple way to create paths is to attach some black tape to a light floor or to print thick black paths on white paper.

Here is one example of a simple follow the line track. You can use this one in order for Smarc to practice or create one of your own.

https://www.youtube.com/watch?v=[illegible]Q-l5ykesgyI



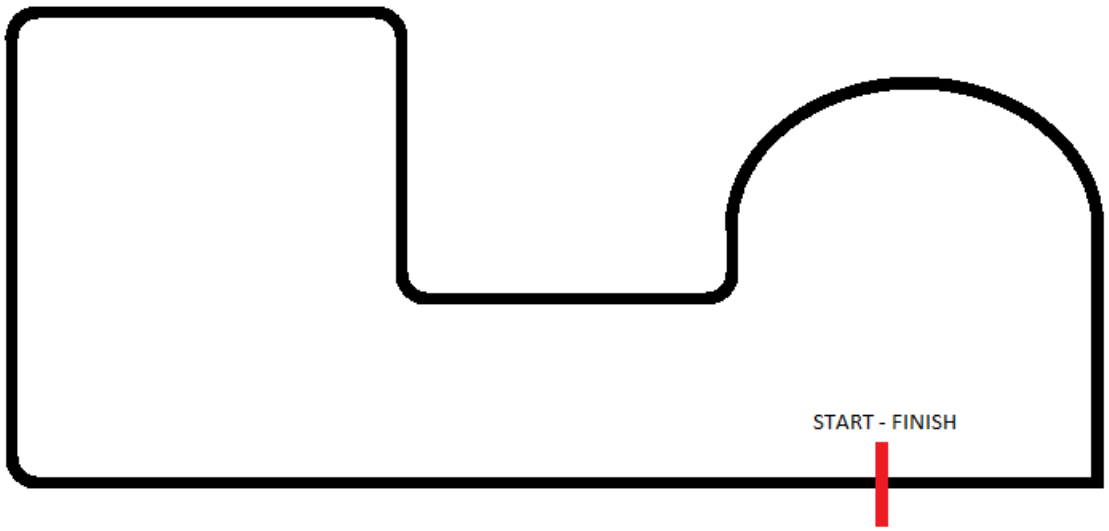
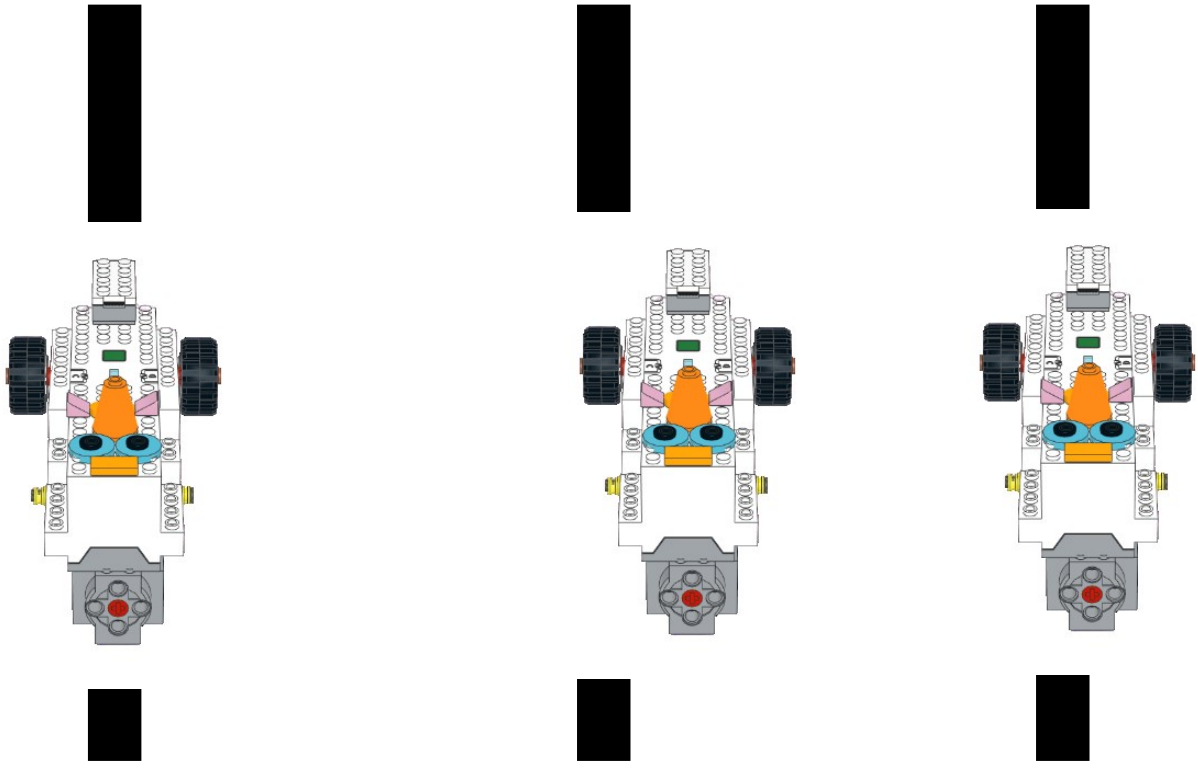


Photo 20-Follow the Line

Ideally, Smarc should aim for the sensor to be between the black line and the white background as shown in the Figure below. We do not want the sensor to be only on the black line or only on the white background.



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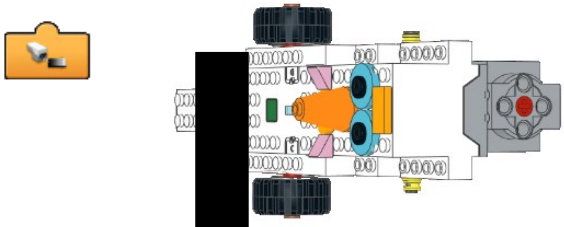
We will then have to take some measurements from the sensor for our track we have created previously in class.

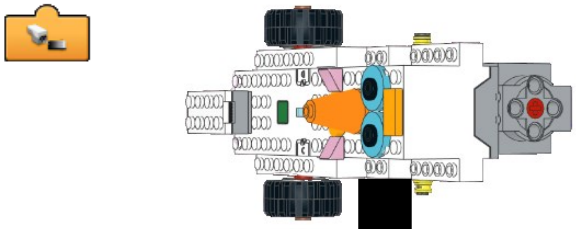
We will need to use the Sensor Light Level Reporte[redacted]ock in order to do so.

There are two ways we can take measurements:

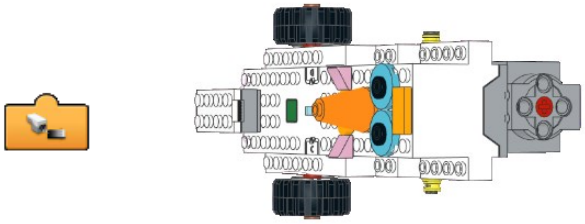
a. By taking one measurement wh[redacted]he sensor is placed in between the black line and the white background as sh[redacted] in Figure.



b. By taking two measure[redacted]s w[redacted] the sensor is placed:
   i) only on the bla[redacted]ne



   ii) only on the white ba[redacted]nd



And then find the average of the two m[redacted]rements taken:

$$\frac{(Black\ Line\ Measurement\ + White\ Background\ [redacted]urement)}{2} = Desired\ Reading\ to\ stay\ on\ correct\ path$$

Example calculation: $\frac{(1+[redacted]}{2}$[redacted]5

[redacted]5

Notes:
Some external factors that affect the sensor readings should be taken into account when taking these readings. These may be the type of paper used for the track (try and avoid glossy paper), the shadows of various objects, such as walls, books, or even the shadows of the students reflected on the track. Try and place your track away from the sunlight of your classroom window and place it directly under the LED lamp, preferably because the light spreads more evenly. As a general rule, you should try and be consistent and place Smarc and the follow the line track at the same exact area as possible.

Another important issue is the color of the line and background. There can be various tones of black and white color so the above measurements are the one's suitable for a specific case. You should take your own measurements which will be the one's suitable for your specific track you have created.

Sample Programs for Following the Line

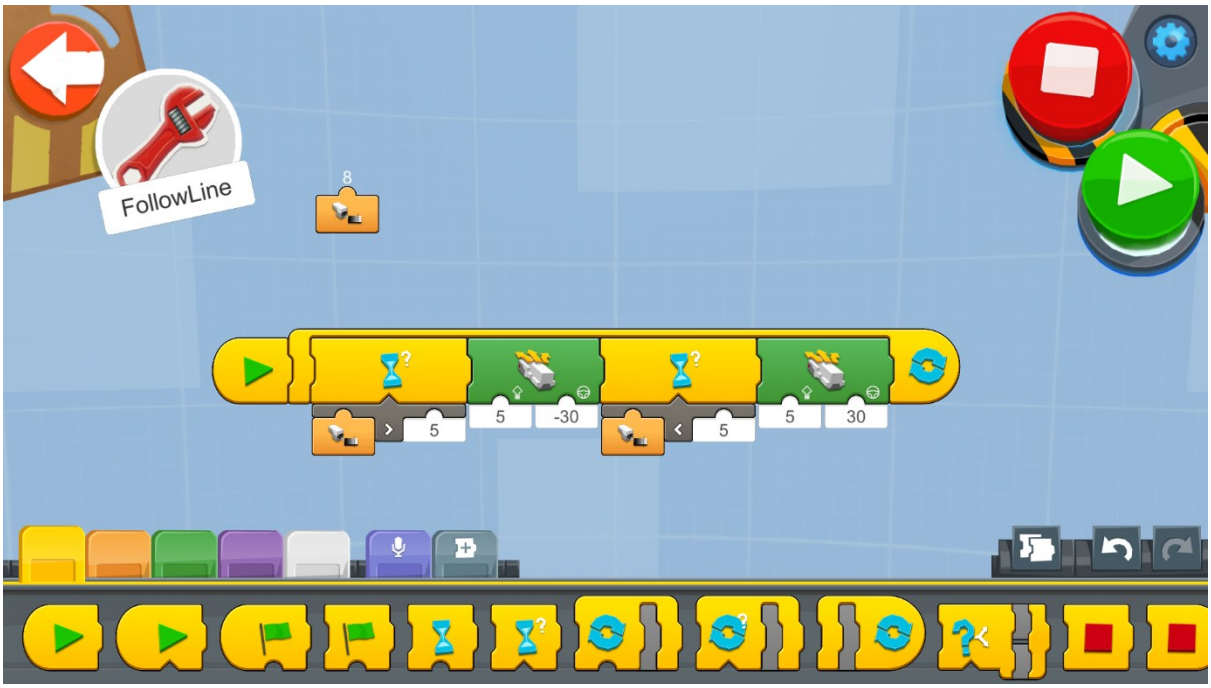


Photo 22-Program - Follow the Line

Create a new project on the Creative Canvas and run the block of code:

1. An Infinite Loop will run the code repeatedly so that Smarc checks all the time for the reading from the sensor and act accordingly.
2. Inside the loop there is a Wait for True Block, which waits for the condition to become true in order to proceed to the next instruction block.
3. Under the Wait for True Block there is a Greater Than Operator which returns True when an input from a sensor and in this case it's the distance and color sensor, is bigger than the value 5 and false if it is equal or less. This will return true if Smarc is drifting away from the black line and the sensor is facing only the white background.
4. If the result of the Wait for True Block condition is True then Smarc moves 30 degrees towards the left (tries to move closer to the black line) using the Drivebase Move Steering block at speed 5 (we try and keep a low speed).

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5. In the second Wait for True Block there is a Less Than Operator which returns True when an input from a sensor and in this case it's the distance and color sensor, is less than the value 5 and false if it is equal or bigger. This will return true if Smarc is getting closer to the black line and the sensor is facing only to the black color of the line.
6. If the result of the second Wait for True Block condition is True, then Smarc moves 30 degrees towards the right (tries to move away from the black line) using the Drivebase Move Steering block at speed 5.
7. Finally, it is always good to have an indication in real time of the values the sensor is sending to the App. For this case, the Sensor Light Level Reporter block is used.

Note: This program will work well only if the sensor is placed on the right side of the line and not on the left!

Robotics4Deaf - Module1. Follow the lines- https://youtu.be/AX0kJ5ngTeY

A second follow the line program:

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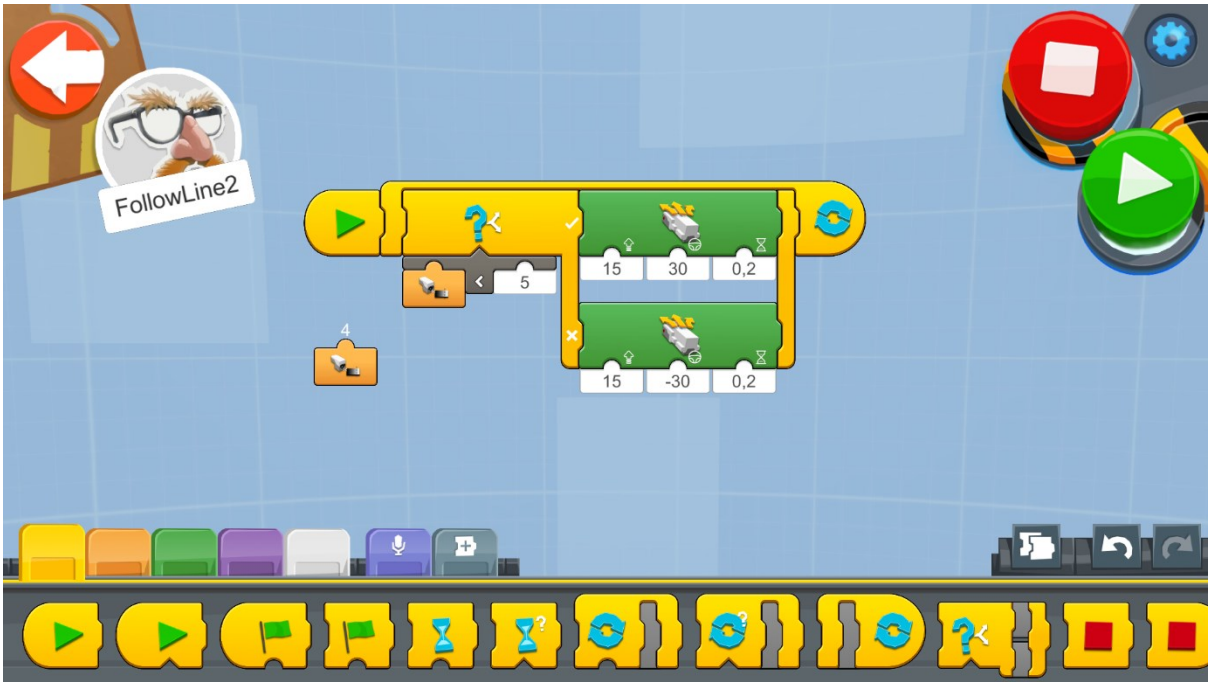

Photo 23- Program 2 - Follow the Line

Create a new project on the Creative Canvas and run the block of code:

1. An Infinite Loop will run the code repeatedly so that Smarc checks all the time for the reading from the sensor and act accordingly.
2. Inside the Loop there is an If/Else block which if it is TRUE, Smarc will move towards the right (tries to move away from the black line) and if it is FALSE, Smarc will move towards the left (tries to move closer to the black line).
3. The Compare Less Than block sets the condition for the Switch block. The Compare Less Than block compares the output of the Sensor Light Level Reporter block to the value 5. It will return true when the sensor is closer to the black line and false when it moves away.
4. If the output of the If/Else block is true, then the Drivebase Move Steering for Duration block will move Smarc at speed 15, at an angle of 30 degrees to the right and will keep on doing this for 0.2 seconds. If it is false, the second Drivebase Move Steering for Duration block will move Smarc at speed 15, at an angle of 30 degrees to the left and will keep on doing this for 0.2 seconds.

Note:
The reason for adding a 0.2 second duration is because of the delay from the time between the readings sent to Smarc until Smarc decides where to move. Therefore, when Smarc has moved close to the black line the decision to move away will need to compensate for the time lost making calculations and transmitting the instruction while Smarc was still moving towards the black line.

Follow the lines 2 - https://youtu.be/BzJ5nq2EHLU

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VII. Detecting Sound with Smarc

A. React on Sound

A sound-activated robot

In this section we will see how we can control Smarc with sounds such as clapping our hands, and by using different sound intensities, with the use of the Sound Sensor blocks.

In the case of Smarc, the sound sensor is actually a built in microphone, which is not located in the Move Hub. Instead, it relies on the microphone, which is located inside of the device, which Smarc is connected to such as the tablet, laptop or a smartphone.

The Lego Boost App does recognize how loud a sound is. Hence, we can program it to react differently depending on the sound intensity it receives.

https://www.youtube.com/watch?v=ybygsyWfOh4&t=1s

B. The Sound Sensor Blocks:

Trigger on Sound Level - Triggers when the sound level measured by the sensor is higher than the sound level shown by the value below it. When it is triggered, it executes the code sequence that follows. It will take 11 values from 0 to 10.

Wait for Sound Level - Waits for the sound intensity measured by the sensor to be higher than the sound level shown by the value below. If the sound level registered is not greater than the value specified, the program remains paused and the following series of instructions begins until the criterion is met. You will take eleven values from 0 to 10.

Sound Level Reporter - Displays the latest sound frequency calculated by a sensor in real time. To be used in a program, it must be connected to the bottom of the other bricks. It will represent values from 0 to 10, including one decimal number, e.g. 7,8.

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Sample Programs for Detecting Sound

Program 1

Photo 24-Program 1- Detect Sound

Create a new project on the Creative Canvas and run the block of code:

1. The code will execute when the Trigger on Sound Level block triggers. This will happen when a noise of level greater than 5 is detected.
2. If the sound is detected, Smarc moves forward using the Drivebase Move Steering block at speed 50.
3. The Wait for Time block is set for 1 second. The reason for this block is for Smarc not to be confused with the same sound used for activating the program to move forward and to trigger the rest of the code.
4. The Wait for Sound Level block waits for a noise of level greater than 5 in order to trigger the execution of the rest of the code.
5. Finally, when the Wait for Sound Level block is triggered, the Drivebase Stop activates and stops Smarc from moving.

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Detecting sound 1 - https://youtu.be/3xrl2SGrlh8

Program 2

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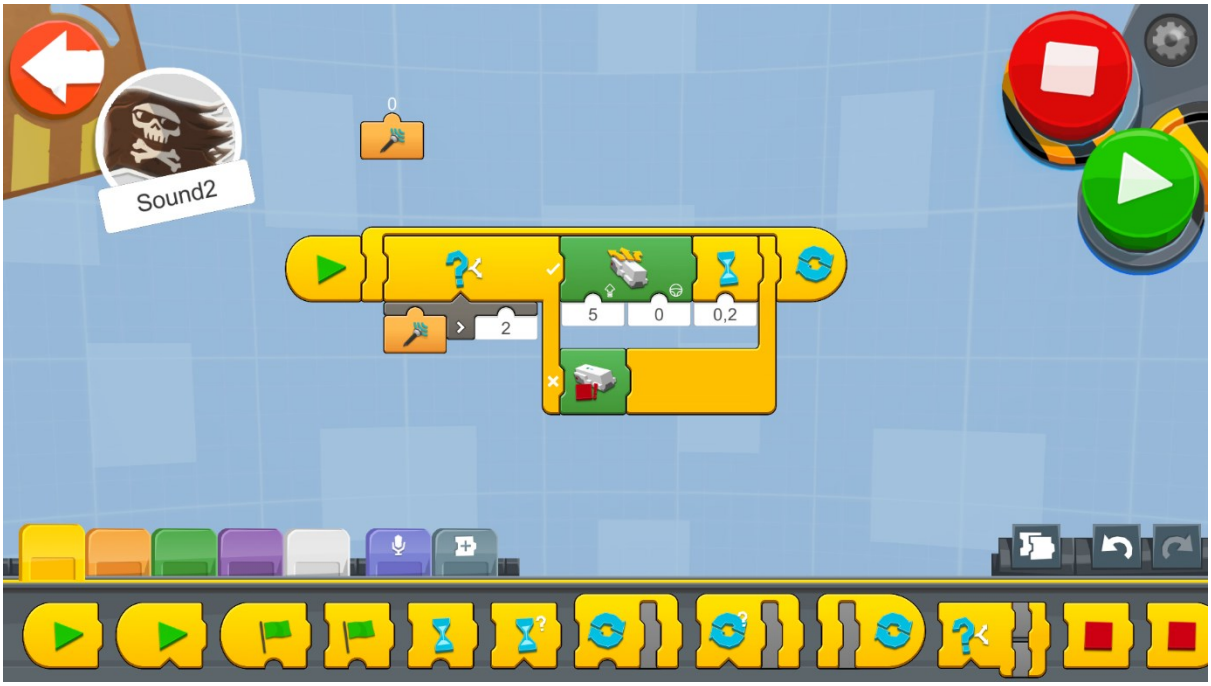

Photo 25- Program 2 - Detect Sound

Create a new project on the Creative Canvas and run the block of code:

1. An Infinite Loop will run the code repeatedly so that Smarc checks the reading from the sensor all the time and act accordingly.
2. Inside the Loop, there is an If/Else block which if TRUE, Smarc will move forward and if FALSE, Smarc will come to stop.
3. The Compare Greater Than block sets the condition for the Switch block. The Compare Greater Than block compares the output of the Sensor Sound Level Reporter block to the value 2. It will return true, when the sensor detects sound levels greater than 2 and false, when it is equal or less than 2.
4. If the output of the If/Else block is true then the Drivebase Move Steering block will move Smarc at speed 55, at an angle of 0 degrees and will keep on doing this for 0.2 seconds. If it is false, the Drivebase Stop block will stop Smarc from moving.

https://youtu.be/oMq_oIyajE0

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VIII. Navigating Smarc with a Remote Controller

A. Remote Control

In this section, we will see how Smarc can move with the use of a remote control.

There are many different ways to communicate with a robot. Robots are most often controlled using either a wired or a wireless controller or they can run autonomously by getting instructions from their control program (which is what we did with Smarc in the previous chapters).

Remote controlled robots can have various scientific uses including hazardous environments such as extreme heat or cold and radioactive locations, working in the deep ocean to place pipes and cables, as well as exploring the outer space and planets.

https://www.youtube.com/watch?v=ZFEJJx9Zlr0

B. The Remote Control Blocks:

Joystick Widget Show - Presents the Joystick Widget in the Lego BOOST App when this block is activated.

Joystick Widget Hide - Hides the Joystick Widget from the Lego BOOST App when this block is activated.

Joystick Widget Speed Reporter - Displays in real time the current Joystick Widget speed (-100..100). In order to be used in a program it needs to be attached to the bottom of other blocks. In most cases it is used as the steering input to a Drivebase Move Steering block. It can show values from -100 to 100 including two decimal values, for example 78,89.

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Joystick Widget Steering Reporter - Displays in real time the current Joystick Widget steering (-100..100). In order to be used in a program it needs to be attached to the bottom of other blocks. In most cases it is used as the speed input to a Drivebase Move Steering block. It can show values from -100 to 100 including two decimal values, for example 78,89.

Sample Programs for Remote Control

Program 1

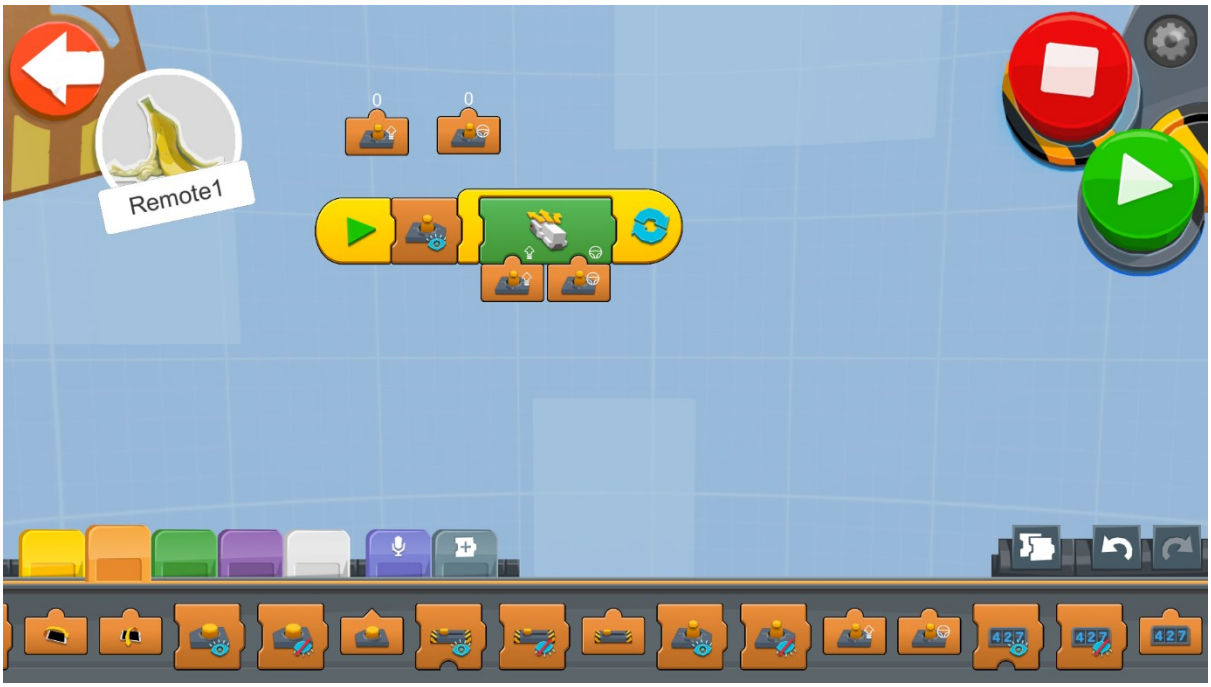

Photo 26-Program - Remote Control

Create a new project on the Creative Canvas and run the block of code:

1. The Joystick Widget Show will show the joystick controller on the app (See Figure).
2. An Infinite Loop will run the code repeatedly so that Smarc checks all the time for the reading from the joystick and act accordingly.
3. Inside the Loop there is a Drivebase Move Steering block which will take as speed input the Joystick Widget Speed Reporter block reading and as direction input the Joystick Widget Steering Reporter block reading.

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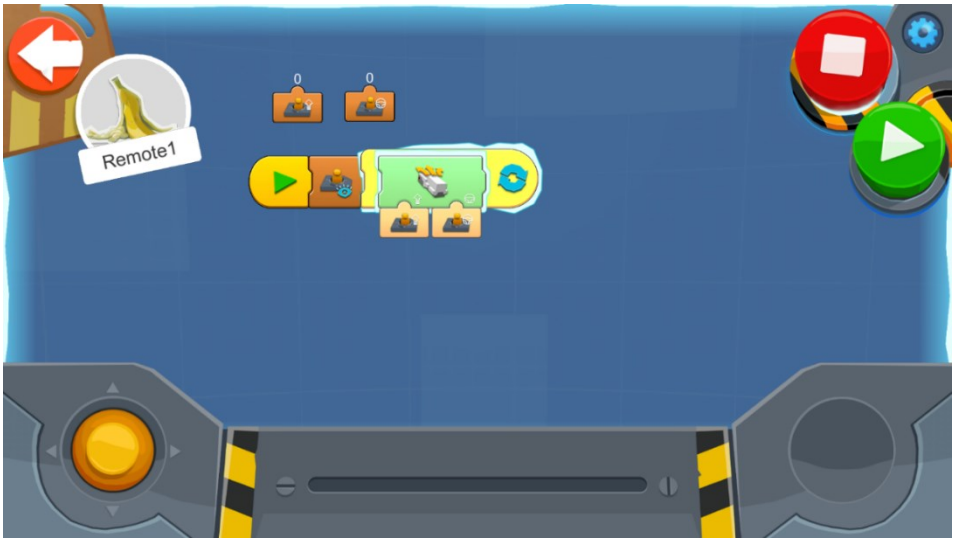

Photo 27-Program - Joystick Controller

Program 2

Photo 28- Program 2 - Remote Control

Sometimes we need more accurate control of Smarc and the input speed is too fast for this. For this we can do a trick in order to reduce the input speed which is sent by the Joystick Widget Speed Reporter block. A Division Operator is used for the speed input of the Drivebase Move block. The input of the Joystick Widget Speed Reporter block is first divided by 4 and then the value is sent as the speed value. For example, if the value reading from the joystick is 100 the speed will be:

$$100 \div 4 = 25$$

So, the real speed input would be 25.

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remote control - https://youtu.be/Tswdypjm7bk

IX. Using Variables with Smarc

A. Mathematics and Calculations

In this section, we'll see how various mathematical operations can be used in combination with variables.

But what are variables?

The code we've created so far didn't need to recall any values because the numbers we used, such as the reflected light and the sound frequency, come from the sensor. There are cases though where we will want Smarc to store and remember a value such as a number in order to use it later in his program.

In order to store numbers in Smarc's memory, you'll need to first assign a name to each memory location to avoid mix-ups.

In the example below, we have two memory locations - containers.

The first container has four Red Lego blocks so we can say that memory location "RED" has the number 4 assigned to it. RED=4.

The second container has three White Lego blocks so we can say that memory location "White" has the number 3 assigned to it. WHITE=3.

https://www.youtube.com/watch?v=gIeh1dx36zU

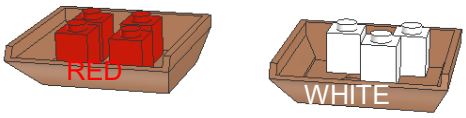

Photo 29-Red and White Lego Boost

The Lego Boost App gives you the option to name the container-memory with the use of only one letter of the English alphabet (Figure) or a symbol of a different symbolic alphabet (Figure).

https://www.youtube.com/watch?v=2OljukD6Qe4

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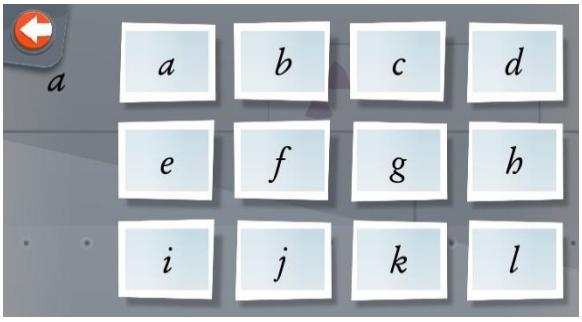

Photo 30- English Alphabet

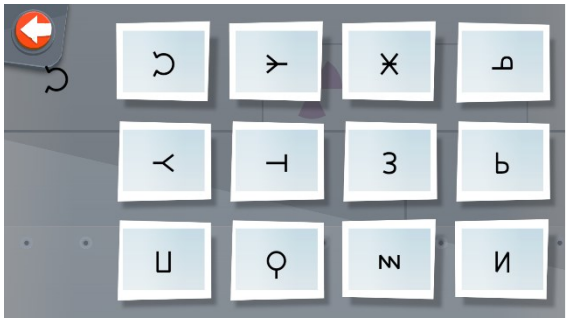

Photo 31-Symbolic Alphabet

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B. The Operator Blocks:

Addition Operator - Returns the result of adding a number to another number.

Subtraction Operator - Returns the result of a number subtracted with another number.

Multiply Operator - Returns the result of a number multiplied with another number.

Division Operator - Returns the result of a number divided by another number.

Equal Operator - Returns True when a number is equal to a value.

C. The Variable Blocks:

Variable Read Local - Displays in real time the number stored in the local variable.

Variable Write Local - Updates the local variable to store the number indicated.

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D. Sample Programs for Mathematics and Calculations

Program 1

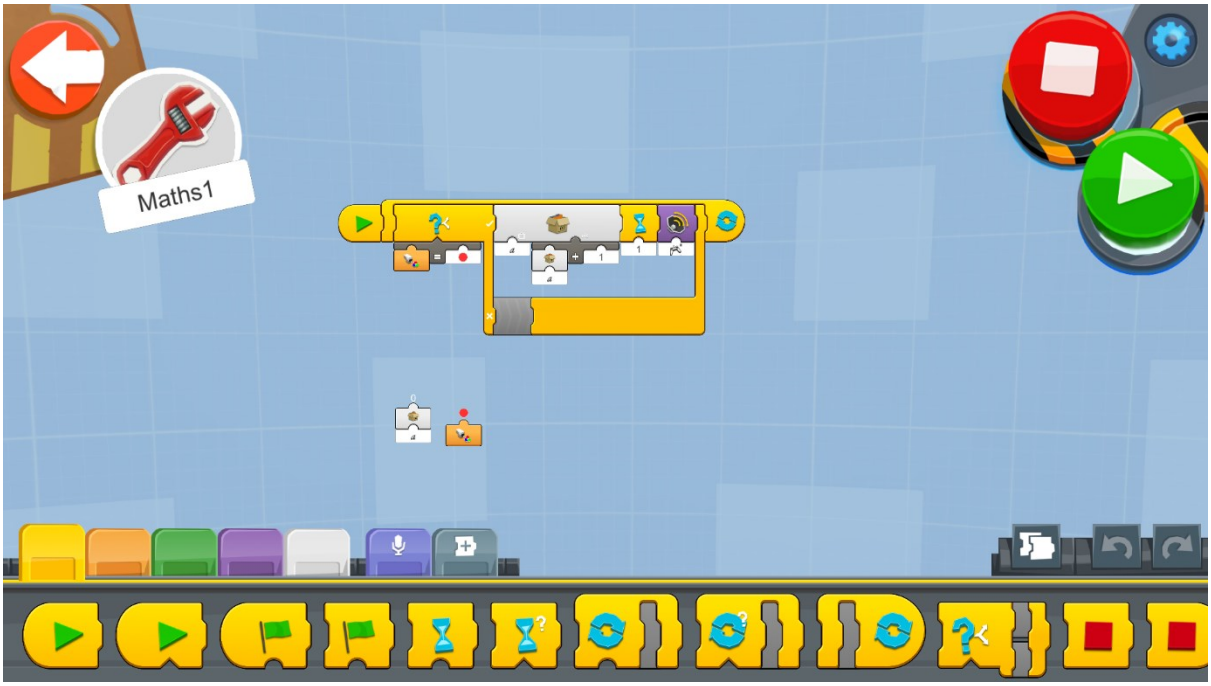

Photo 32-Program - Mathematics and Calculations

Create a new project on the Creative Canvas and run the block of code:

1. An Infinite Loop will run the code repeatedly so that Smarc checks all the time for the reading from the sensor and act accordingly.
2. Inside the Loop there is an If/Else block, which if the sensor detects a RED color, the contents of variable “a”, will increase by 1.
3. After each increase of the variable by 1 the wait block is activated for 1 second. The reason for this is for the variable not to increase more than once when the red color is detected.
4. Finally, the sound block triggers right after each increase for the user to know that the variable was increased.

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Program 2

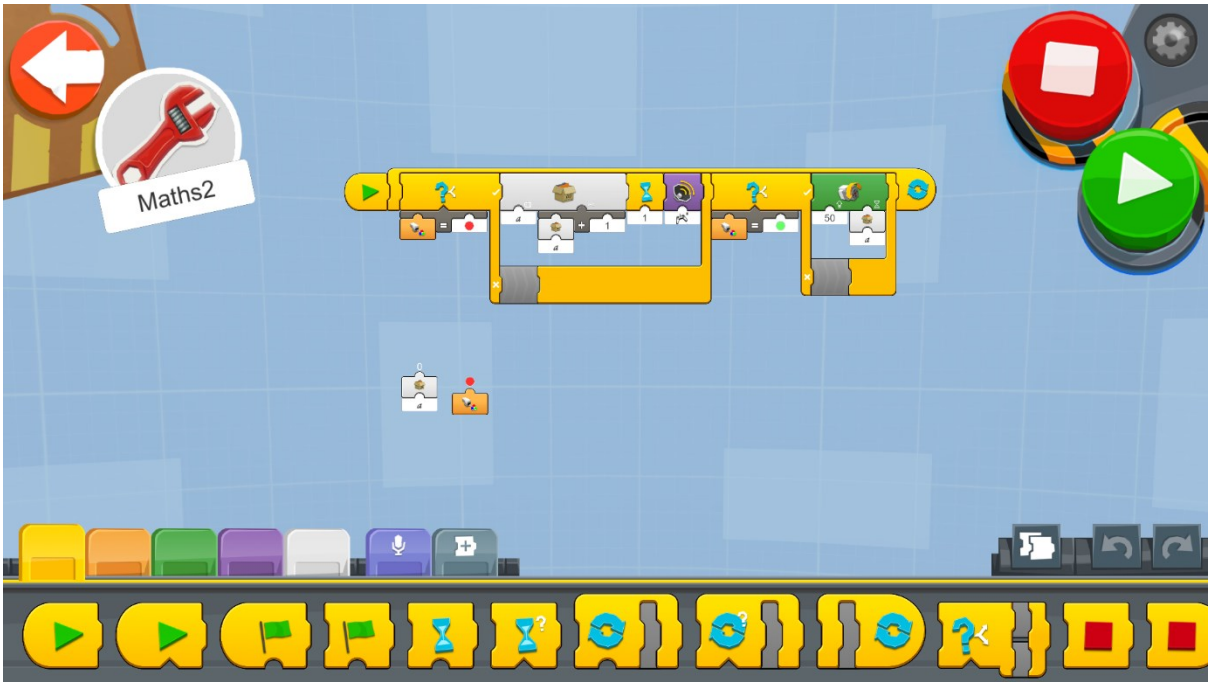

Photo 33-Program 2 - Mathematics and Calculations

From the previous created program, complete the additional code as shown above.

1. The second If/Else block returns TRUE if the sensor detects a GREEN color.

2. If the result of the If/Else block is TRUE, the medium motor will turn at speed 50 for time (in seconds) equal to the content of variable “a”.

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www.robotics4deaf.eu