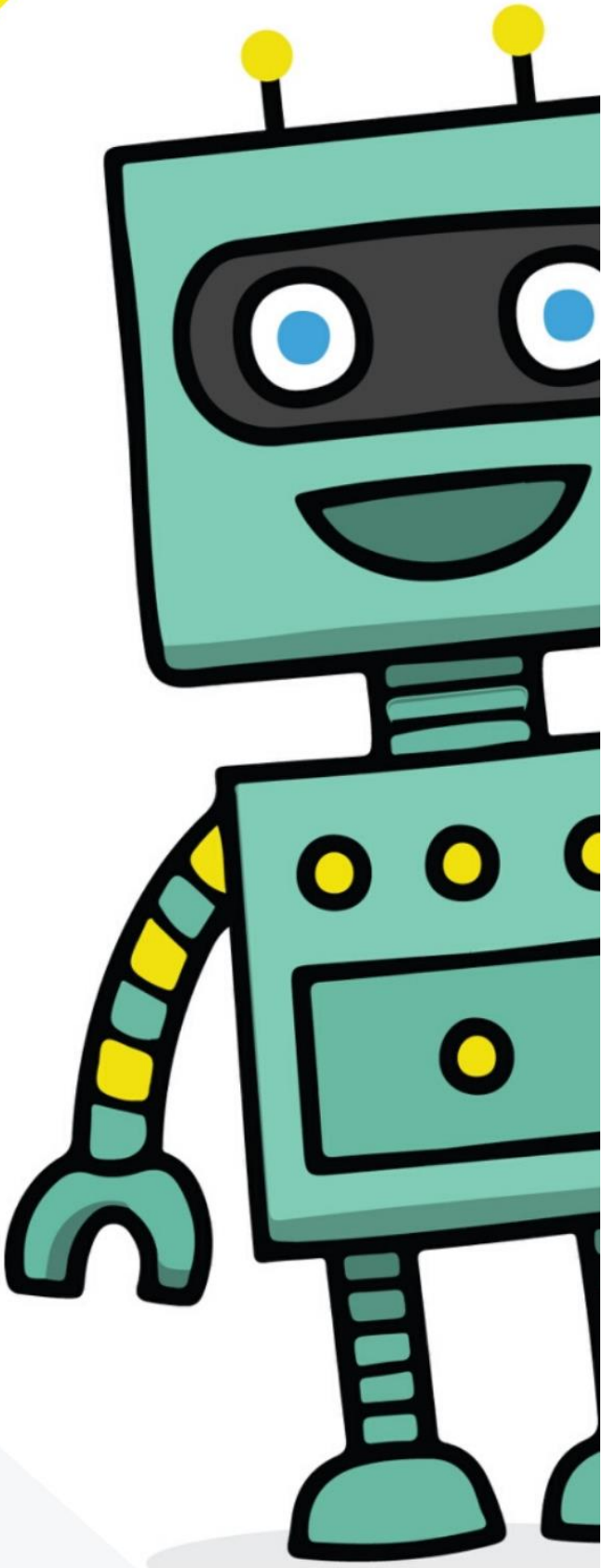

CODESKILLS
4ROBOTICS

# THE CREATIVE SCENARIOS

PRIMARY SCHOOL EDUCATION

Erasmus+

INFORMATION

TITLE OF THE OUTPUT:
EDUCATIONAL BACK PACK

MODULE 1 - DEVELOP BASIC STEM SKILLS AND PROGRAMMING

PROJECT INFORMATION

PROJECT: ERASMUS+

PROJECT TITLE: CODESKILLS4ROBOTICS
PROMOTING CODING & STEM SKILLS THROUGH ROBOTICS: SUPPORTING PRIMARY SCHOOLS TO DEVELOP INCLUSIVE DIGITAL STRATEGIES FOR ALL

PROJECT NO.: 2018-1-EL01-KA201-047823

PROJECT COORDINATOR: N.C.S.R DEMOKRITOS

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TEI of Crete
Technological Educational Institute of Crete

LIFELONG LEARNING PLATFORM
EUROPEAN CIVIL SOCIETY FOR EDUCATION

Emphasys CENTRE

Hälsinglands Utbildningsförbund

REGIONAL DIRECTORATE OF PRIMARY AND SECONDARY EDUCATION OF CRETE

# Table of Contents

# 1. Building and Programming Small Robots

In Module 2, the focus is on the implementation of the four (4) creative scenarios. In these scenarios the pupils will use three (3) of the main constructions of the Lego Boost kit, namely, Vernie, M.T.R.4 and Guitar 4000. First though, they must build them and get familiar with their capabilities.

This process will mainly take place through the application provided by Lego. The Lego Boost app is designed to provide students with step-by-step instructions on both assembly and basic functions for each construction. The consortium has prepared extra material explaining in detail the step-by-step guide capabilities of these robots. This material acts complementary to the app so that students can better understand what they are building with Lego and its capabilities. This part comprises the first chapter of Module 2.

## 1.1 The Lego Boost Constructions



In the following links, you can find the documentation (pdf files) we have also prepared with instructions on how to build in a step-by-step process the five (5) main constructions of Lego Boost that you can find in the following links:

1. Vernie
2. M.T.R.4.
3. Guitar4000
4. Autobuilder
5. Frankie the Cat

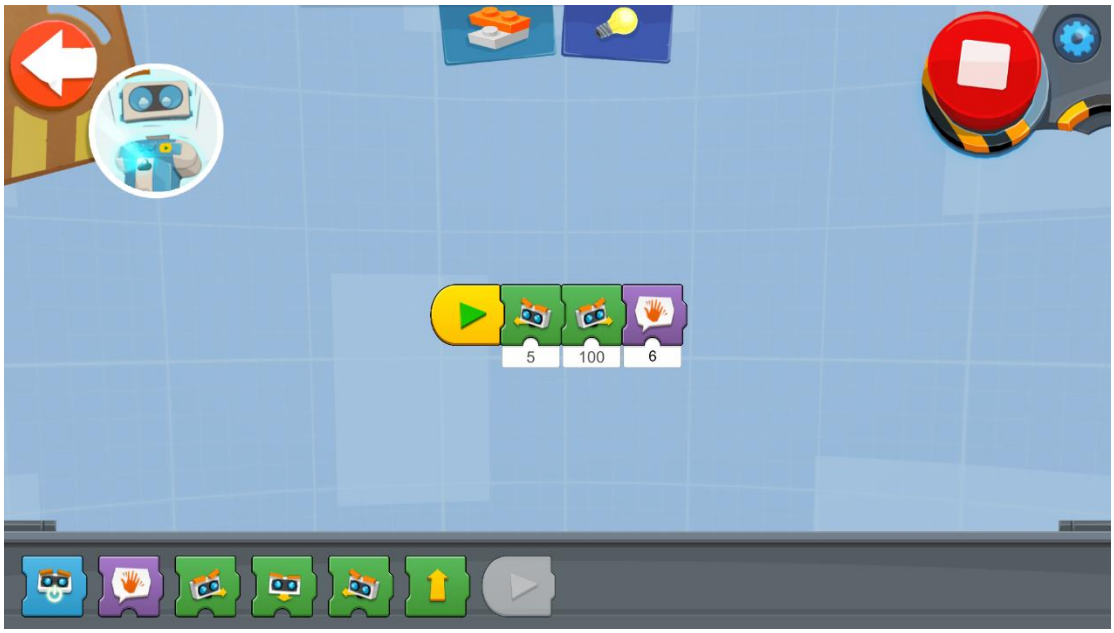
The purpose of these pdf files is to replace the Lego Boost App only for the construction (building) of the robots in the case where either the teacher wants to minimize the use of tablets by the students or the Lego Boost App crashes for some reason.

As it has been mentioned before, for the purposes of this project and its four (4) creative scenarios, only the first three (3) constructions will be used (Vernie, M.T.R.4 and Guitar 4000).

## 1.2 Vernie

### 1.2.1 Vernie's Movement and Communication

Vernie can move his head and move himself around. He can also communicate by using small phrases and questions.

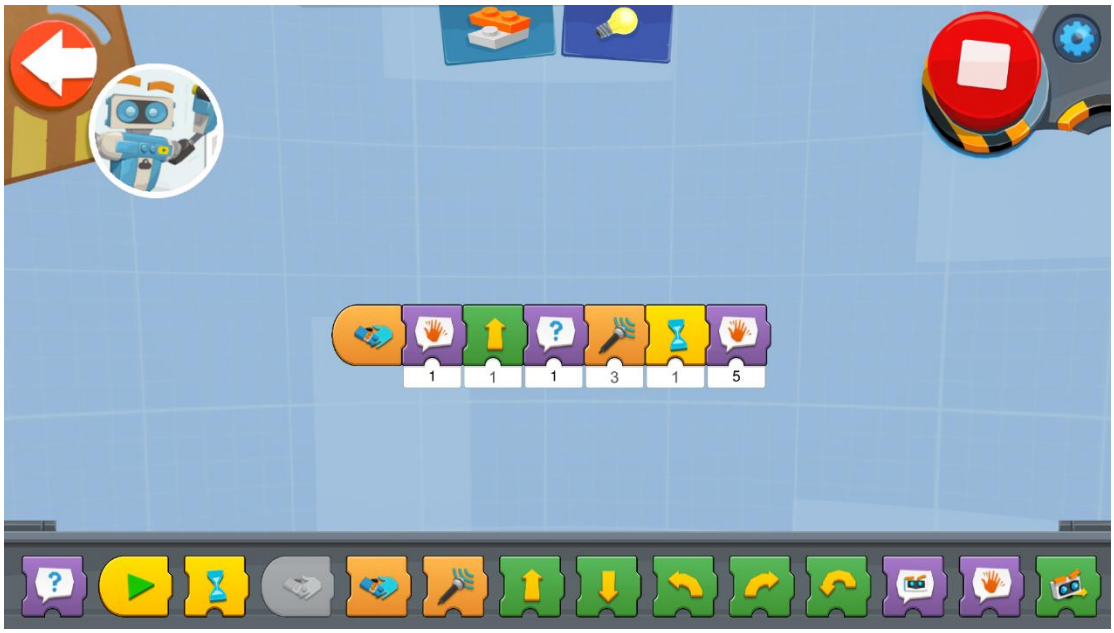



The above program controls Vernie's head movement. The first block controls the speed of the left side movement and the second the speed of the right side movement. The third block, makes Vernie utter a small phrase.

In the second program Vernie moves himself around. You can control the "steps" of the movement and the degrees of the turns. You can also make Vernie swing around himself.

Notice the last two blocks. Is there any difference between them?

There are many ways that can trigger Vernie to act. In the following program, two new ways are demonstrated (Orange Blocks).



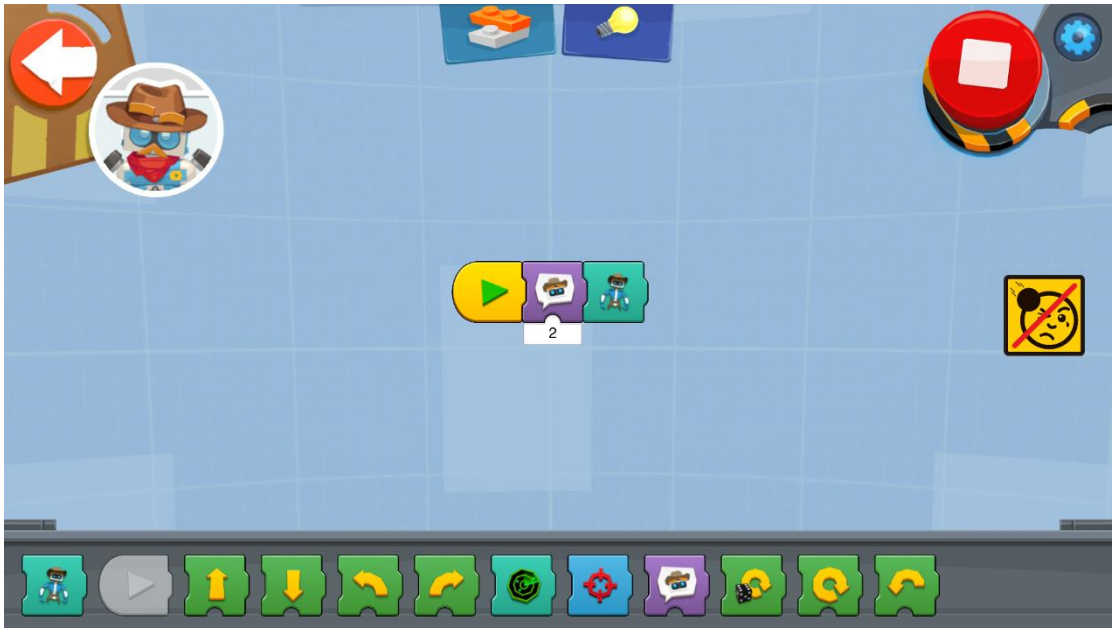

The program is activated when we shake Vernies' hand. It makes Vernie say hello, move a "step" and ask a question. Then he waits until the second orange block has been activated. This block uses the sound sensor to determine the level of sound. When the sound reaches the selected level, the block is activated and the rest of the program runs.

### 1.2.2 Vernie as a Cowboy

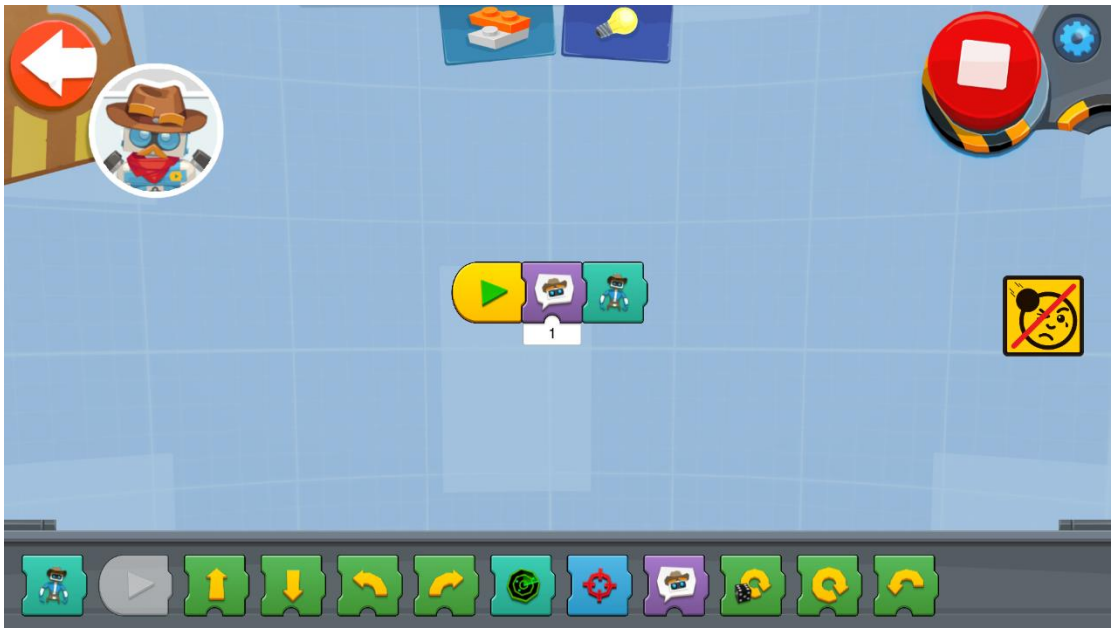
**Shoot the Target**

With the blue block, Vernie shoots an arrow.

The second block makes Vernie wait and aim until you clap your hand. The moment he hears the sound, Vernie shoots the arrow.

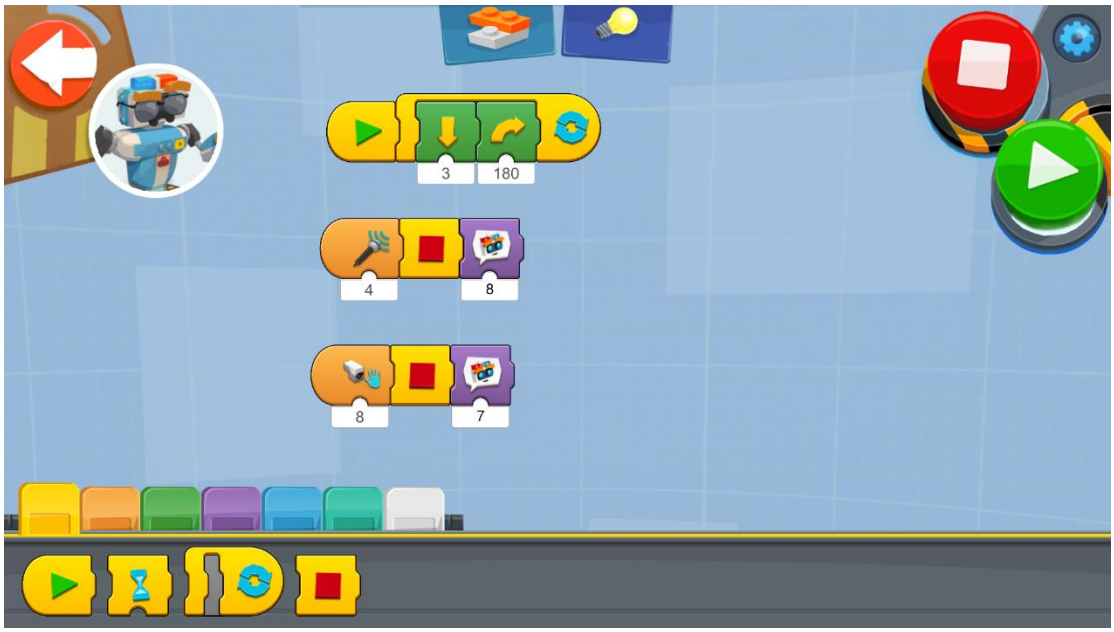



The above program makes Vernie enter in a duel with you. You need to be prepared and push the button quickly.

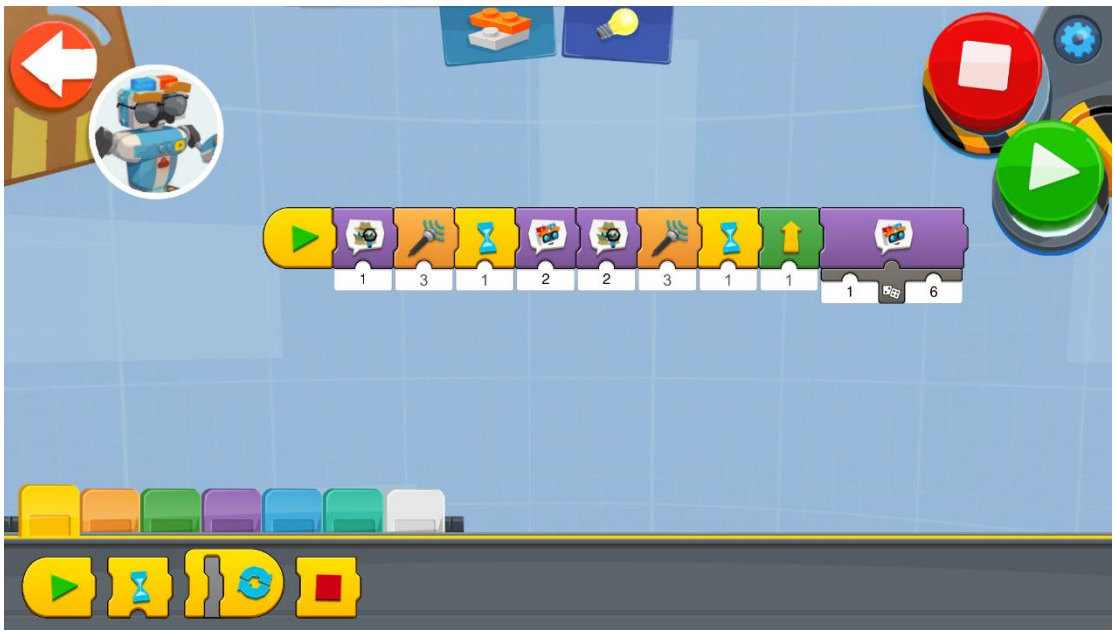



With this program, Vernie rotates in a random mode until he shoots.

### 1.2.3 Vernie as a Police Officer




With the above program, police officer Vernie uses different triggering conditions. The first loop makes Vernie walk around until a sound or an obstacle is detected. Then a subprogram is activated.

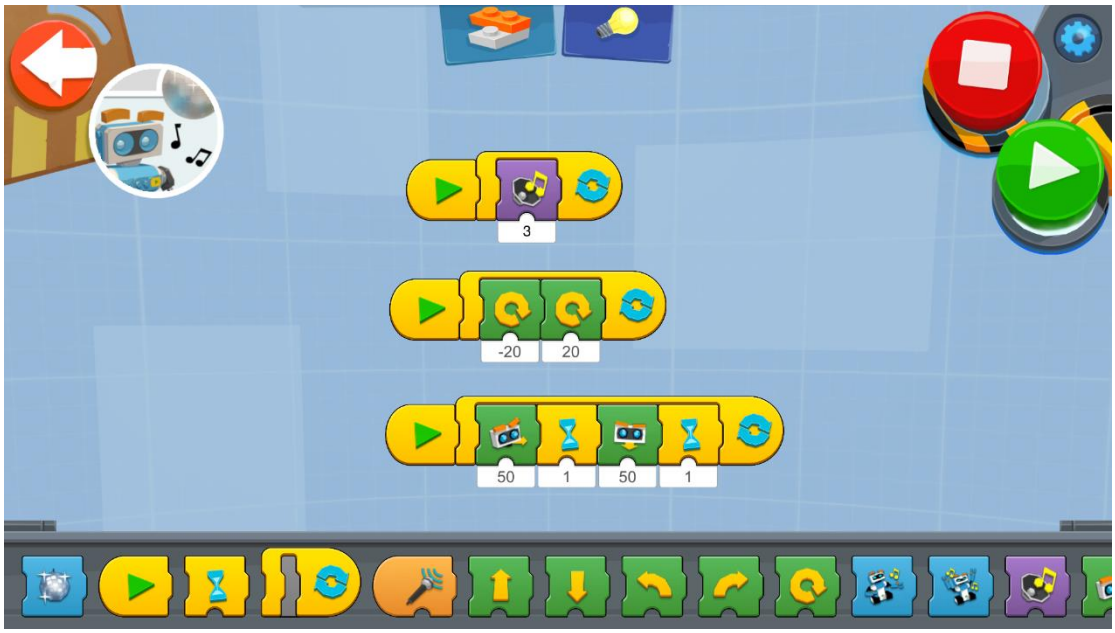



With the above program Vernie asks you some questions (cop questions). The interesting thing here is that in the last block of the program cop Vernie is using a random phrase.

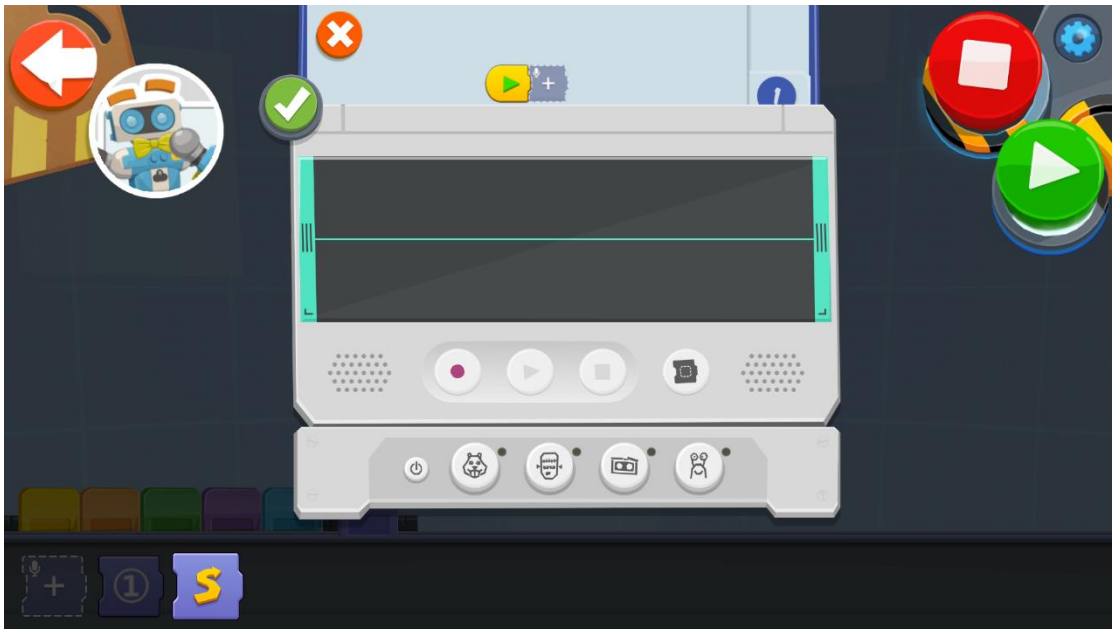
### 1.2.4 Vernie as a Dancer

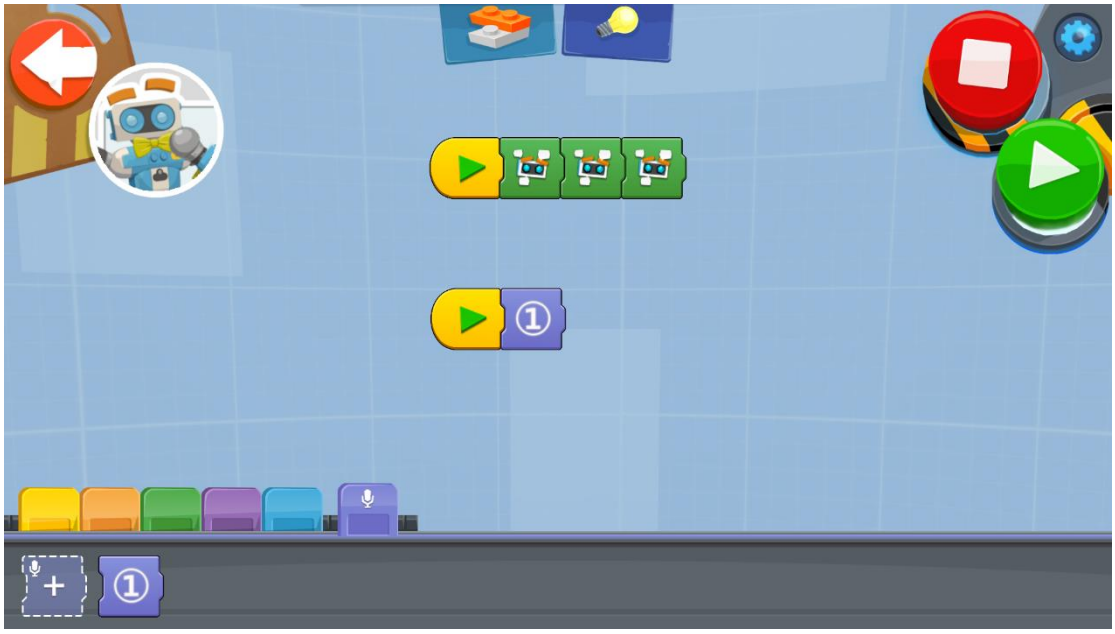
With this program, Vernie creates a disco atmosphere and starts dancing when he hears music.


You can make Vernie dance as you want. The above program is just an example. There are no rules, but always keep the music playing!!!



### 1.2.5 Vernie as a Singer



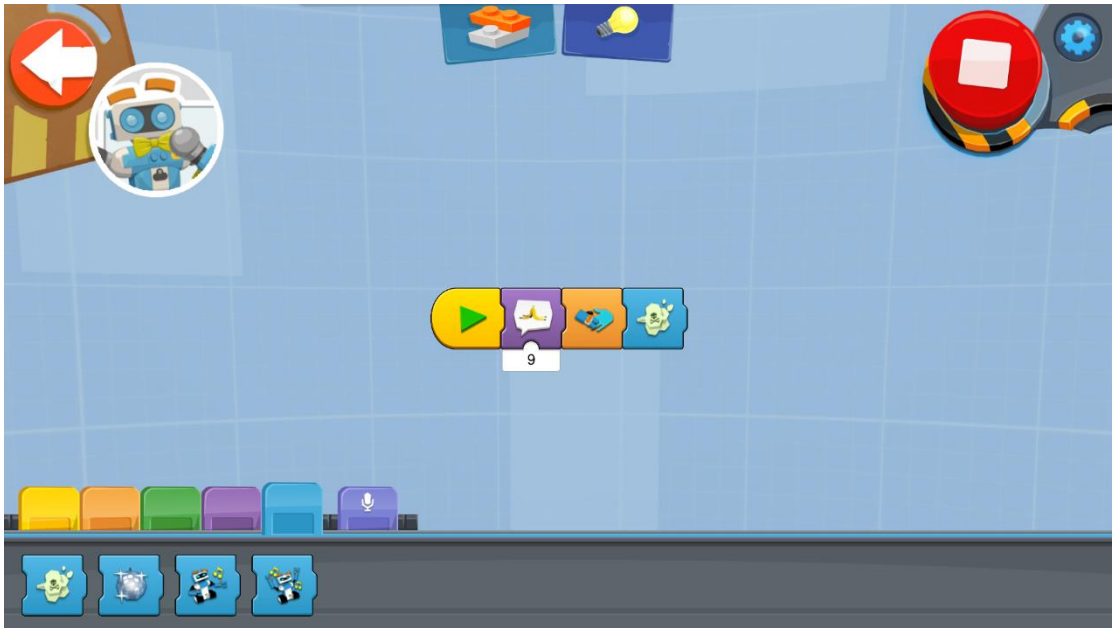


You can record anything you like and Vernie will sing it. On the microphone section block, you will find the record function. Every time you record something, a new voice block is created and you can use it on Vernie.

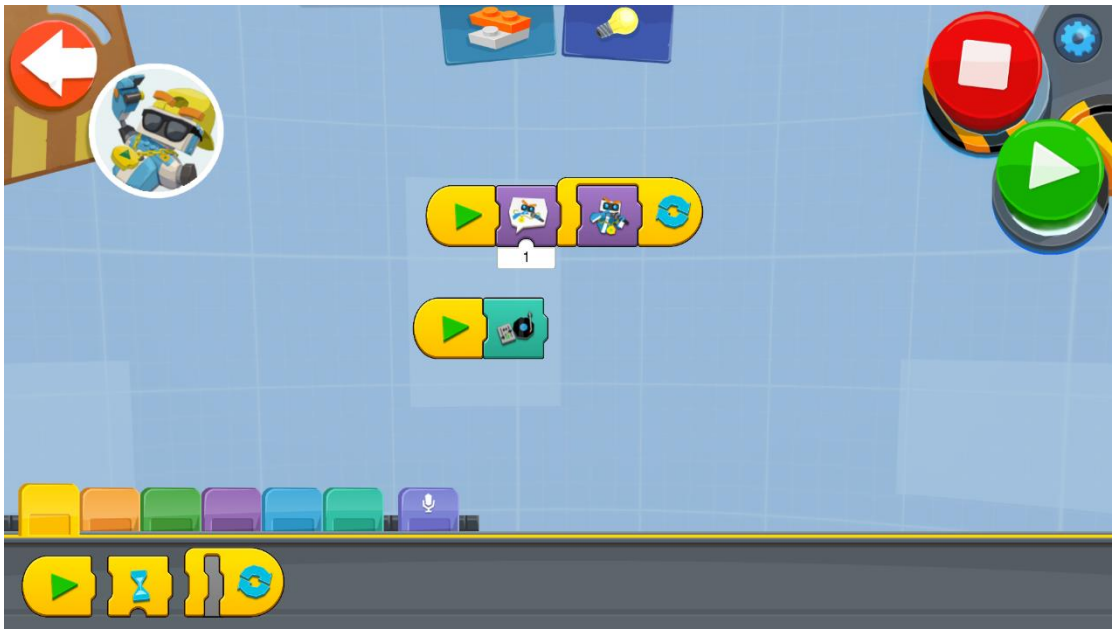
The green blocks used in the above program make Vernie move his head in random.

There is a huge variety of sounds in the purple and blue block sections. Just be as creative as you can…

Try to run this program and you will understand what we mean by that…


9

### 1.2.6 Vernie as a DJ

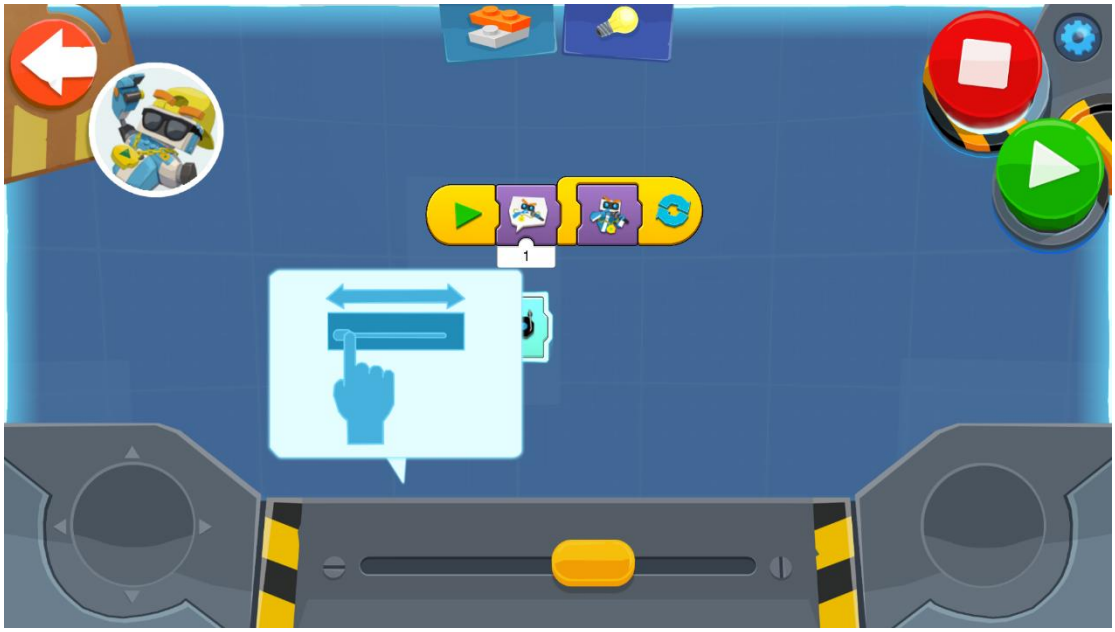


Use sound effects with the above program.

### 1.2.7 Vernie as an Athlete

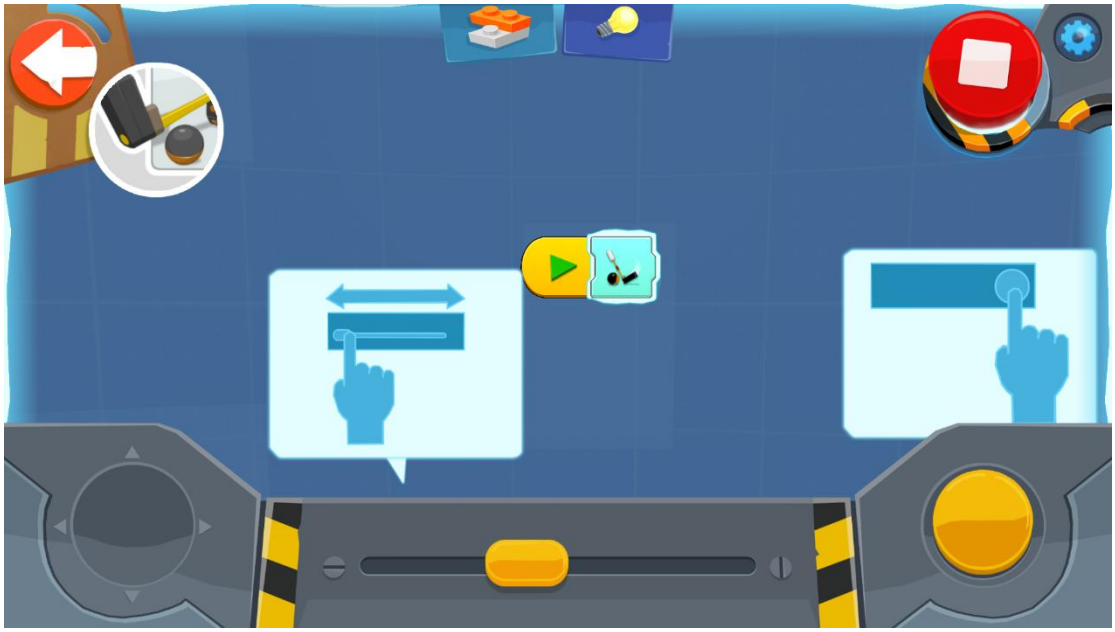
**Vernie is racing**

You can control Vernie through your tablet with the following program. Just push the button to accelerate and use the slider for steering.



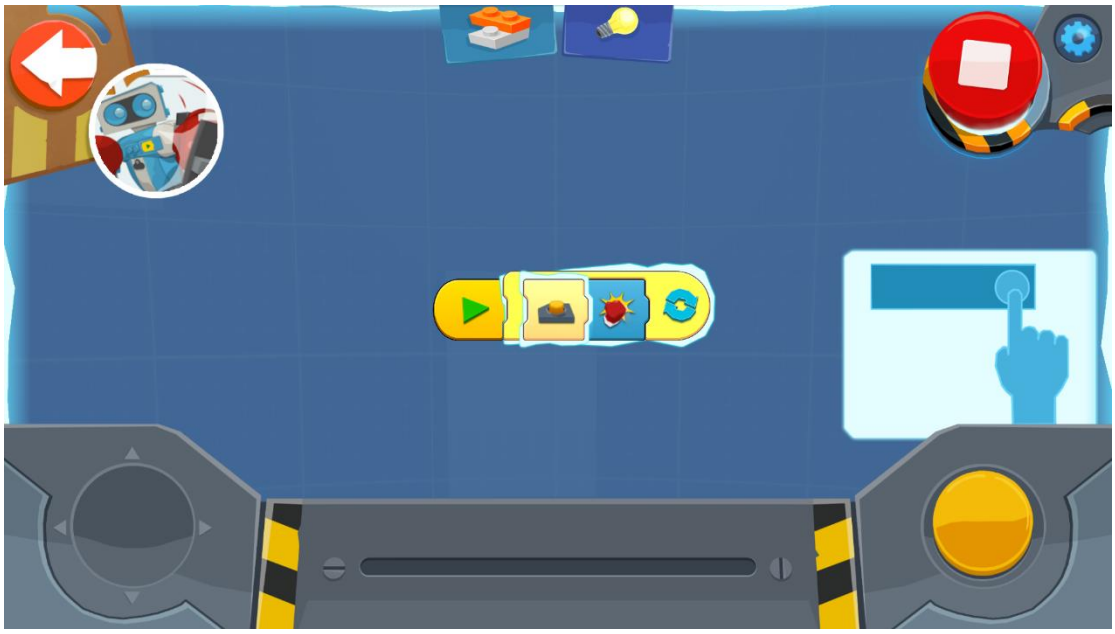
**Vernie is playing golf**

Play some golf with Vernie. This program allows you to control his stick.



**Vernie is a Boxer**

With this program, every time you push the button Vernie will give a punch.



### 1.2.8 Vernie's Sub-programs


On the blue block section, there are some blocks that contain sub-programs. When you choose those blocks, a blue program window pops up. In this window, you can see the program that is "hidden" inside the block. You can always modify these blocks as you like, by clicking on the blue window.

## 1.3 M.T.R.4

### 1.3.1 M.T.R.4 the Lifter


With the above program, we test the lifting arm of the vehicle. The first block detects an object near the sensor. When an object is detected, the next blocks of the program are executed and the object is lifted.


In the turquoise area of the menu, we can find the block, which allows us to operate the vehicle via the tablet. We can use this function in combination with other functions.

In the above example, we can operate the vehicle with the tablet and when it encounters an object, it automatically lifts it.

### 1.3.2 M.T.R.4 the Destroyer


By making the appropriate modifications you can turn the M.T.R.4. into a destruction machine. With the program shown in the figure above, every time the vehicle detects an object near it, it hits it with the hammer.


You can also use this feature in combination with other functions. For example, the above program makes M.T.R.4 move straight and every time it finds an object in its way, it smashes it.

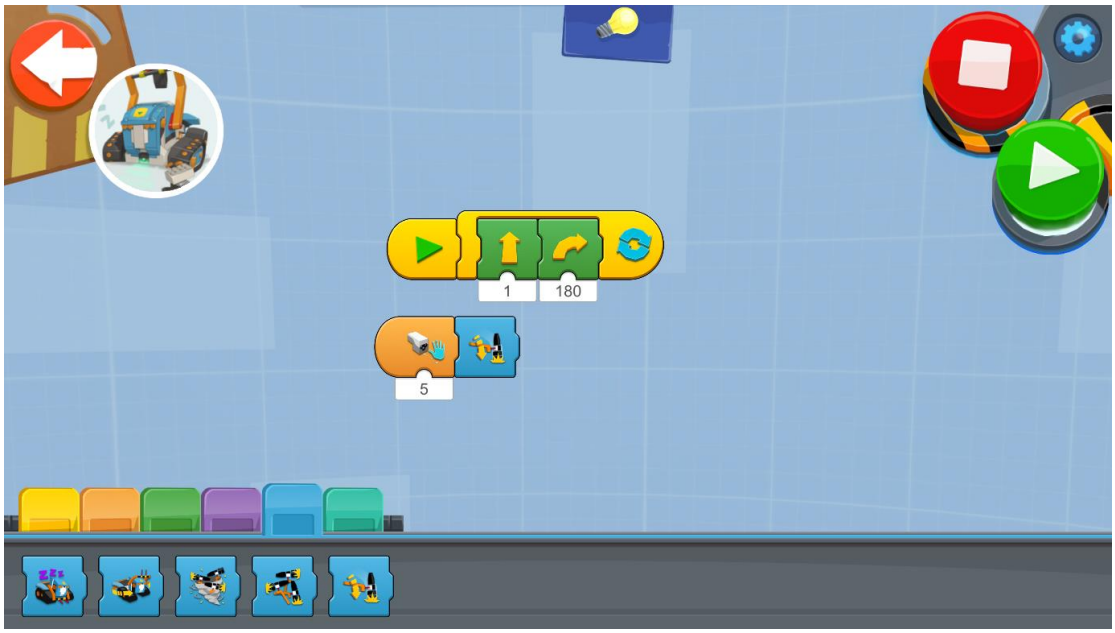
### 1.3.3 M.T.R.4 Attack with the Catapult

You can use the vehicle's hammer in numerous ways. For example, you can make a catapult out of Lego pieces and use the hammer to trigger it. You can use the joystick widget to control the vehicle. When M.T.R.4 is in the right position, you can press the button to activate the hammer.

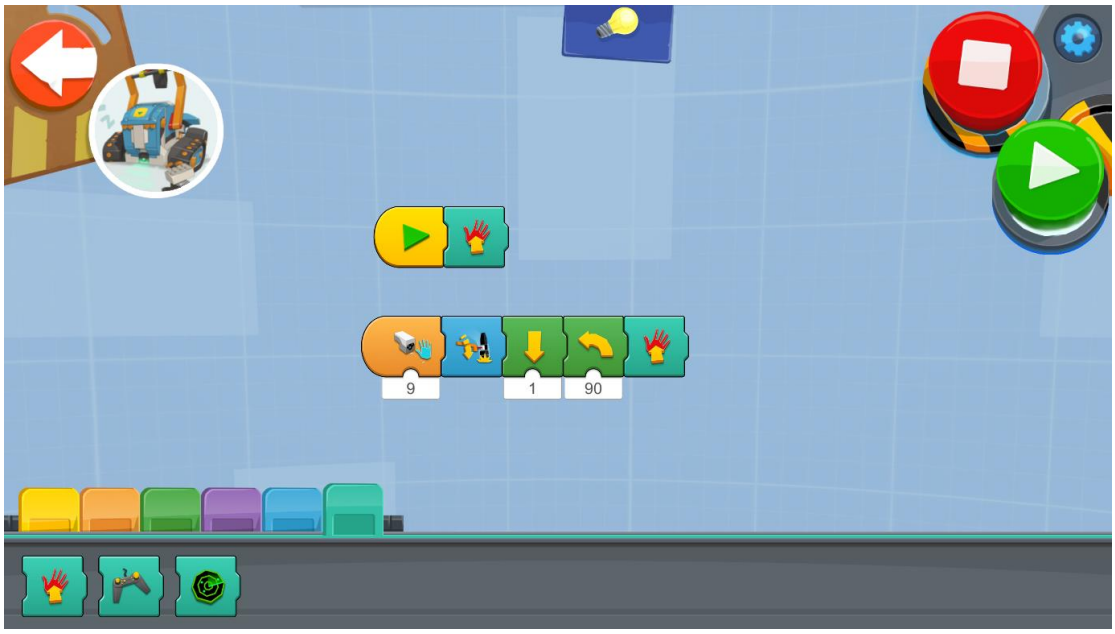
### 1.3.4 M.T.R.4 Search and Destroy

You can program your robot to search the area around it and destroy whatever objects it finds. With the following programs, our M.T.R.4 does that in two completely different ways.

In the first program, we use a "forever loop" to make M.T.R.4 move around and a sensor-triggering block, which activates the hammer each time an object is detected.



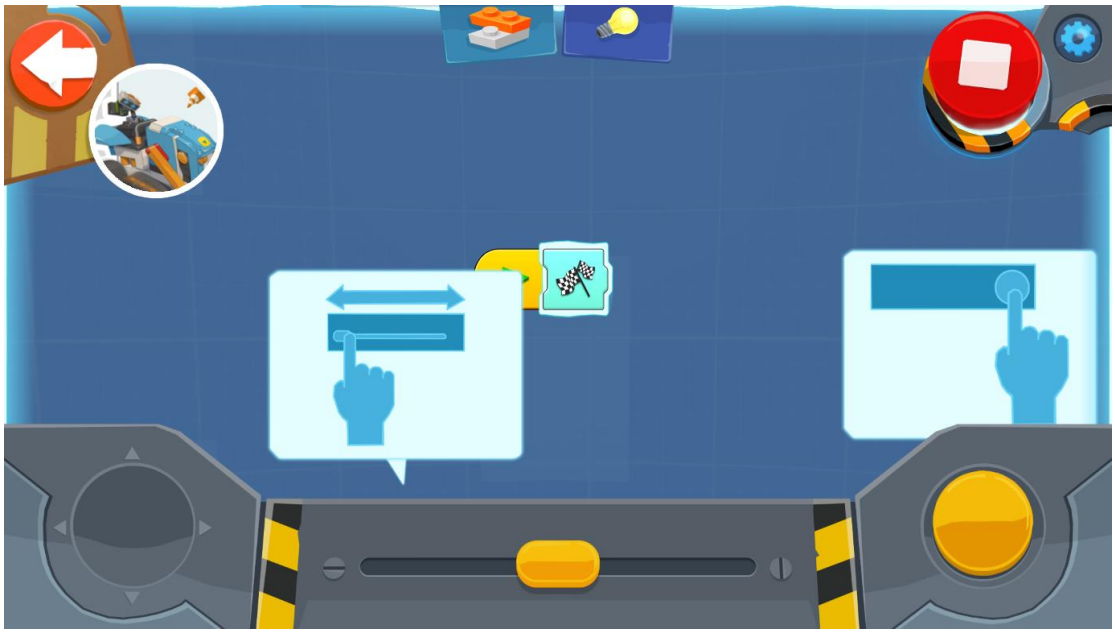

In the second program, we use a different approach in order to make M.T.R.4 search the area around it. By using the turquoise block shown in the image below, we set our vehicle to move straight ahead until it meets a wall, while using the distance sensor to detect objects in front of it. Then it makes a step back, rotates itself for 90 degrees and continues its way.



### 1.3.5 M.T.R.4 Racing

With the following turquoise block, you can take control of M.T.R.4 to race through a track.

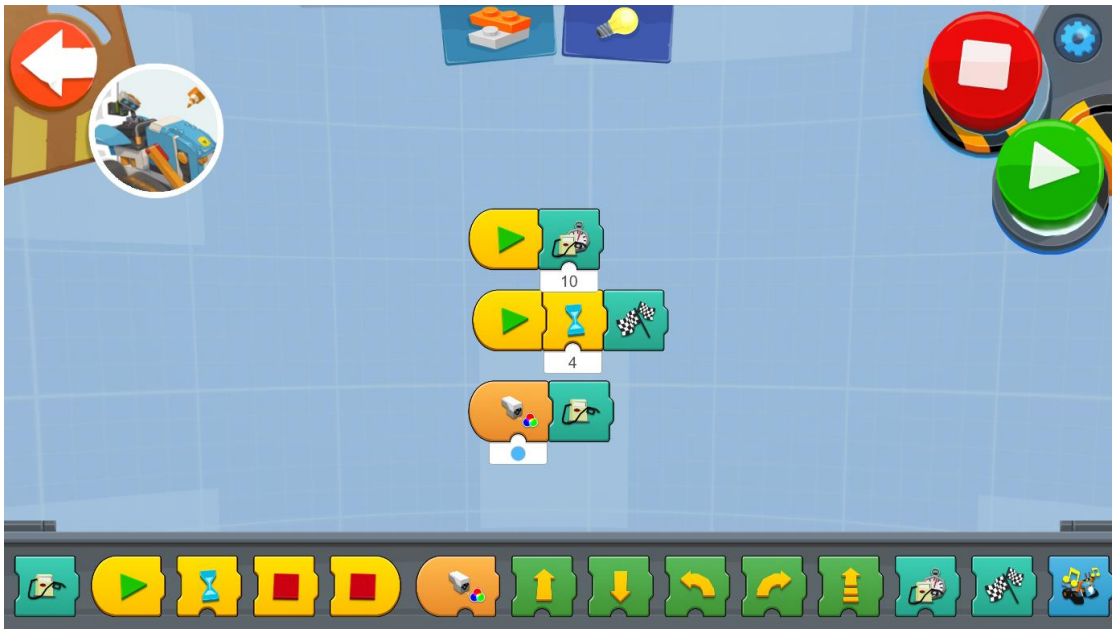
Hold down the Button Widget to speed up, let it go to slow down and use the Slider Widget to control the steering.



### 1.3.6 M.T.R.4 Racing Challenge

You need to make a track suitable for this Challenge. Each contestant will have a specific time to get to a checkpoint. If the M.T.R.4 arrives on time, the timer will be reset to give you time to reach the next checkpoint etc. Every mistake makes you waste time and if you fail to get to the checkpoint on time, the game is over. The following program does just that.

In the first row, the turquoise block starts the timer for a specific number of seconds (we chose 10 seconds but it is actually up to you to decide). In the third group of blocks, we have a triggering mode that requires the detection of the color blue (you can always choose another color) by our color sensor. When that happens, the turquoise block resets the timer to its original value (10 seconds). Therefore, our checkpoints need to be colored blue (for example a blue post it on the ground) in order to reset the timer.



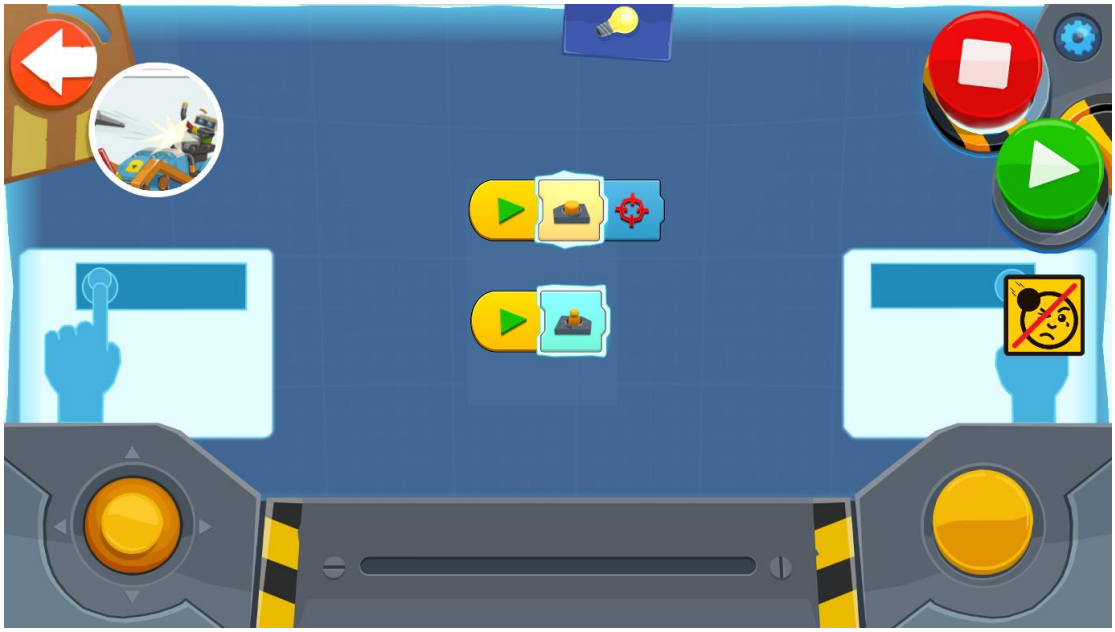

We could make the challenge even more interesting with some adjustments. For example at some point along the way, you can add a target that the vehicle should aim for.

In the following program, we have added a new triggering mode, which shoots the arrow when we clap our hands. It is up to you to add as many more tasks as you want.

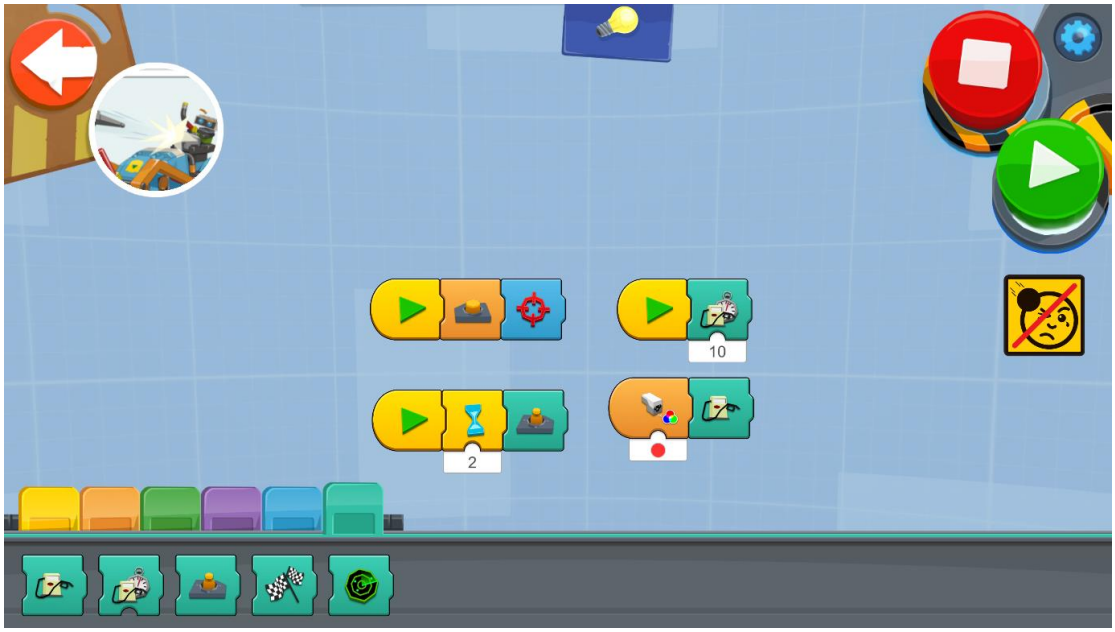

5
4
10

### 1.3.7 M.T.R.4 Joystick Configuration

You can configure the joystick widget to control the M.T.R.4 in other ways. In the following program, we added two turquoise blocks. The first block is checking if the joysticks' button is pressed and when the condition is met, M.T.R.4 shoots the arrow. The second one allows us to control the vehicle with the joystick.



You can also use these configurations in the previous challenge (Racing Challenge).

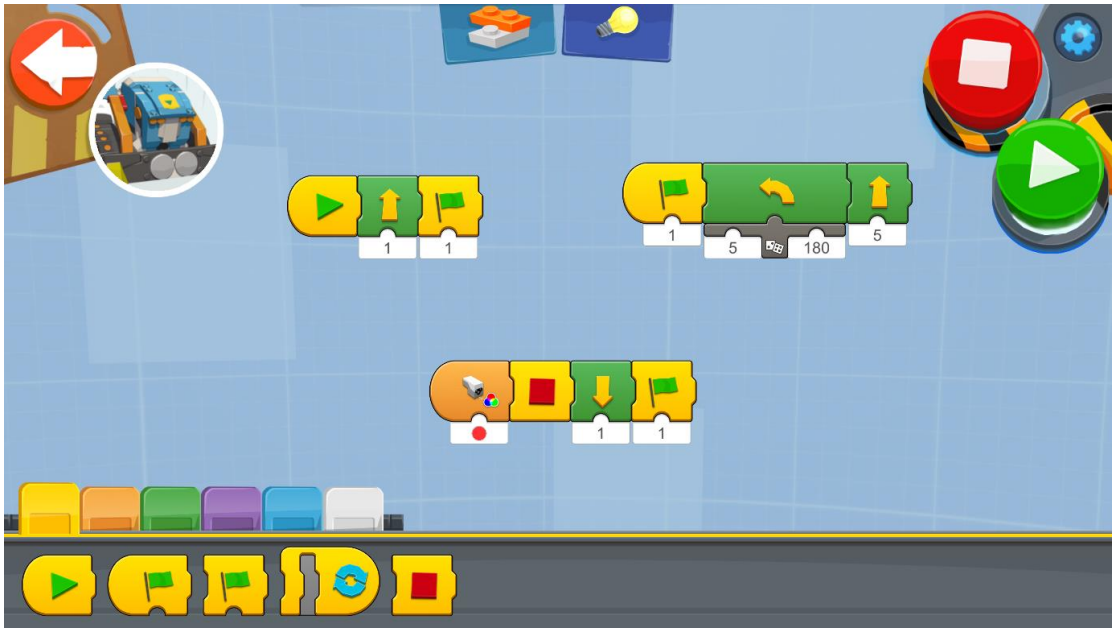


### 1.3.8 M.T.R.4 Program Trees

In the yellow section of the menu, you will find two blocks with a flag on them. One of them can be used inside a program and the second one is a starting method block. When a program activates the first block, the starting method with the same number is running.

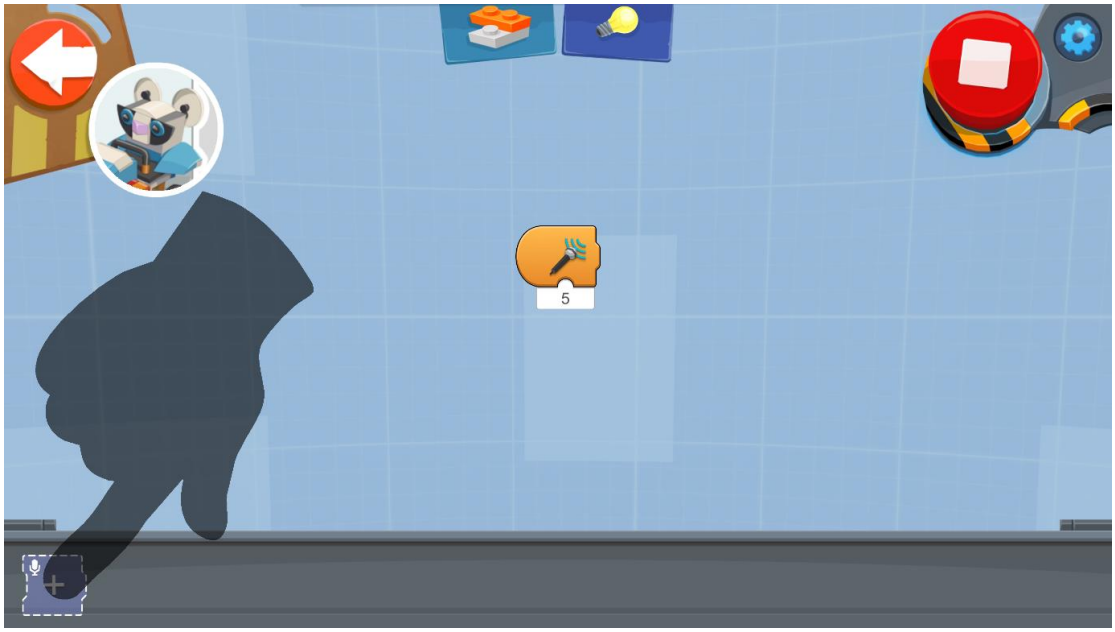
For example, the following program is designed to help you remove any leftover Lego pieces on your play mat. The first group of blocks is activated only once at the start of the program. The M.T.R.4 makes a step forward and then the flag block is activated.

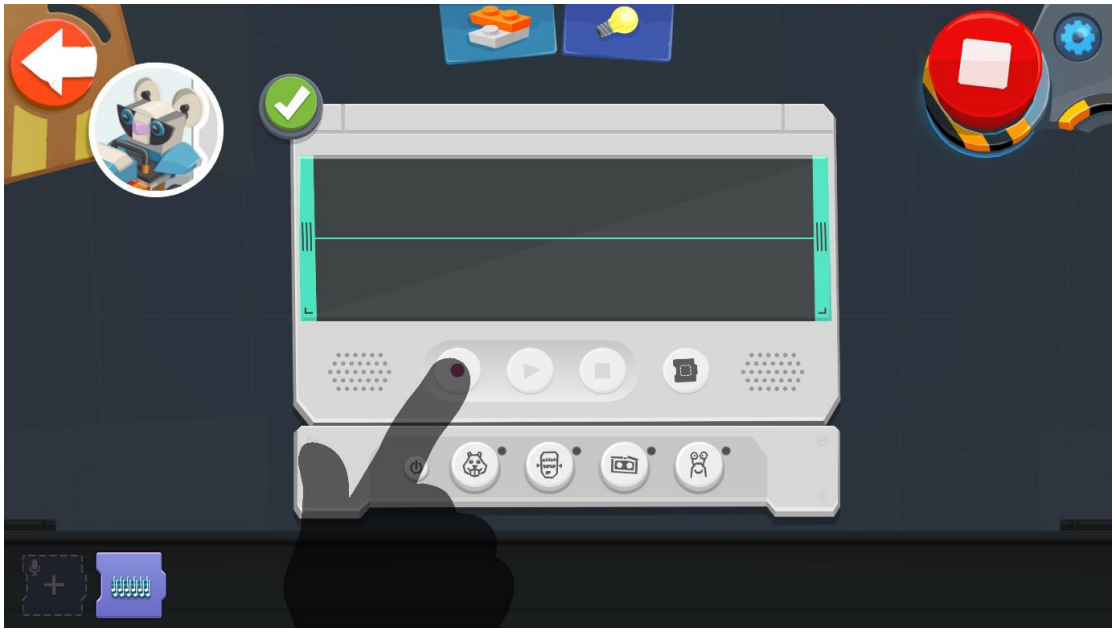
The vehicle rotates itself for random degrees and then it moves for five steps forward. If the sensor detects the color red (the boundaries of the cardboard are painted red) the vehicle stops, makes a step back and the flag start method is activated again. This way, our vehicle always stays within the limits of the cardboard.



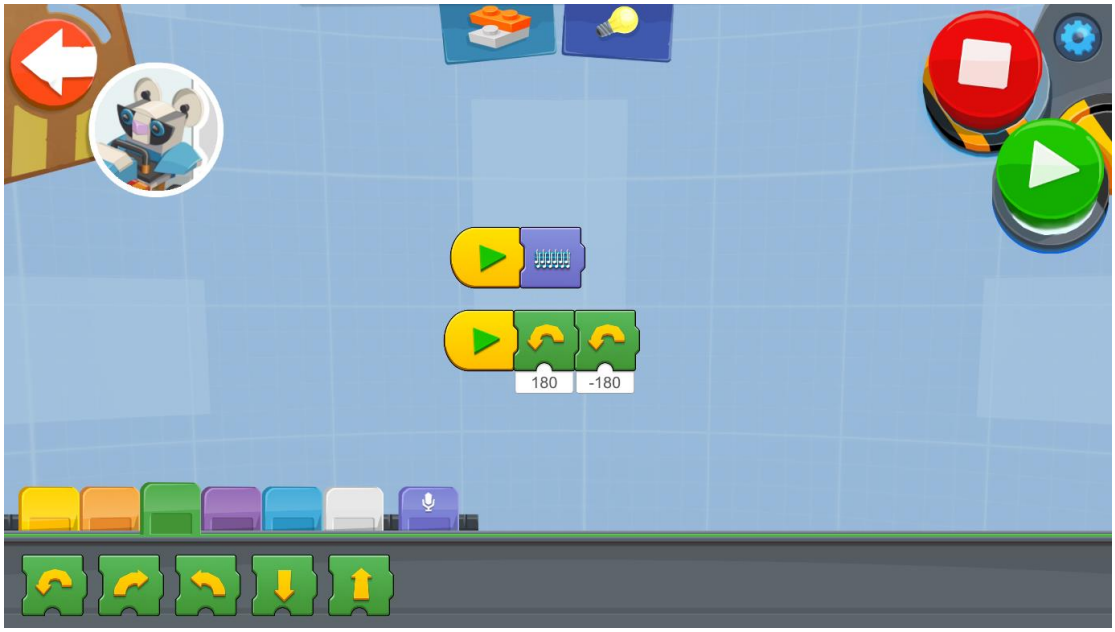
### 1.3.9 M.T.R.4 Record and Playback Sounds

In the purple section of the menu with the microphone image, you will find a block, which allows you to record a sound. After that, a new sound block is generated and that sound can be used.



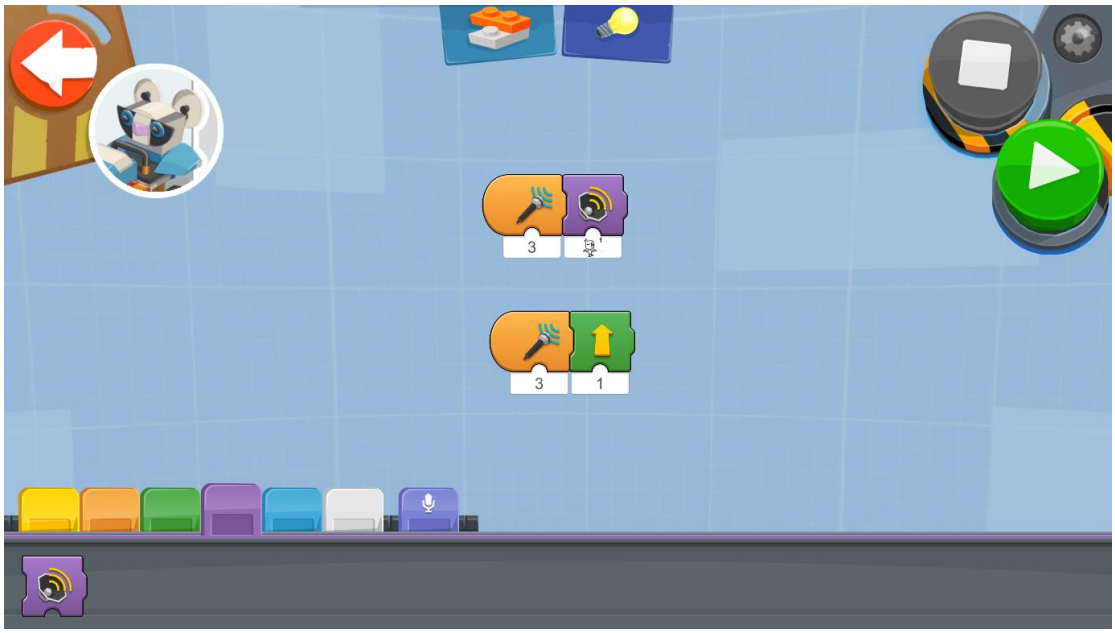



Here is an example of a program, which makes M.T.R.4 rotate itself while it generates the sound, just like dancing or maybe yelling. There are unlimited opportunities to use this block… Give them a try!




Of course, there are a number of prerecorded sounds for you to use and you can use them with all the starting methods.

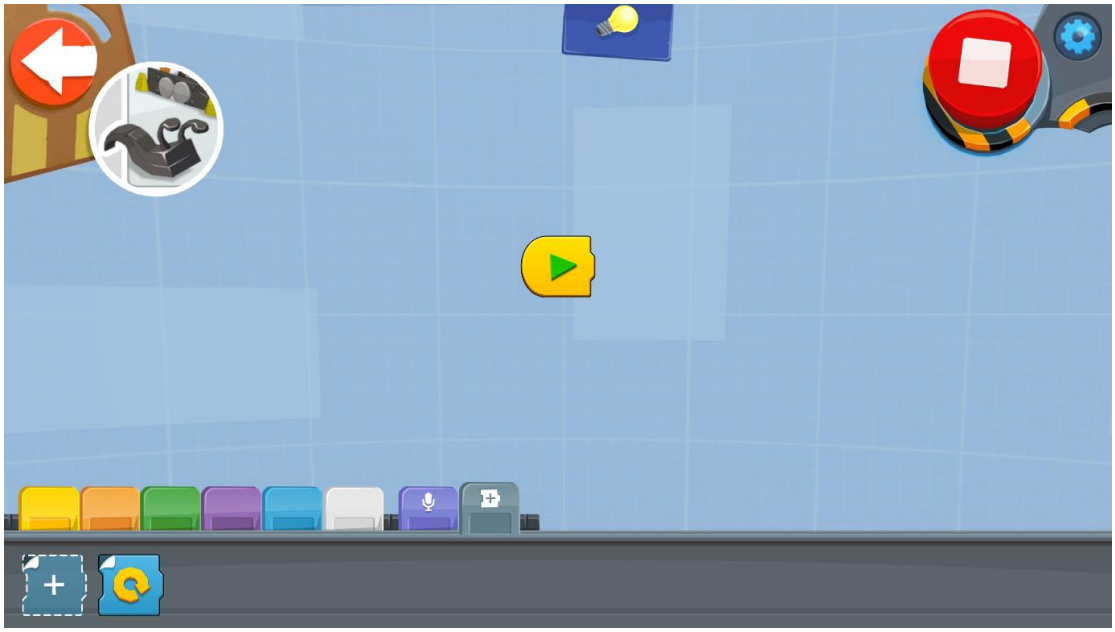
In the following program, we make the M.T.R.4 react to the clap of our hands. It makes a step forward and produces a sound in response.

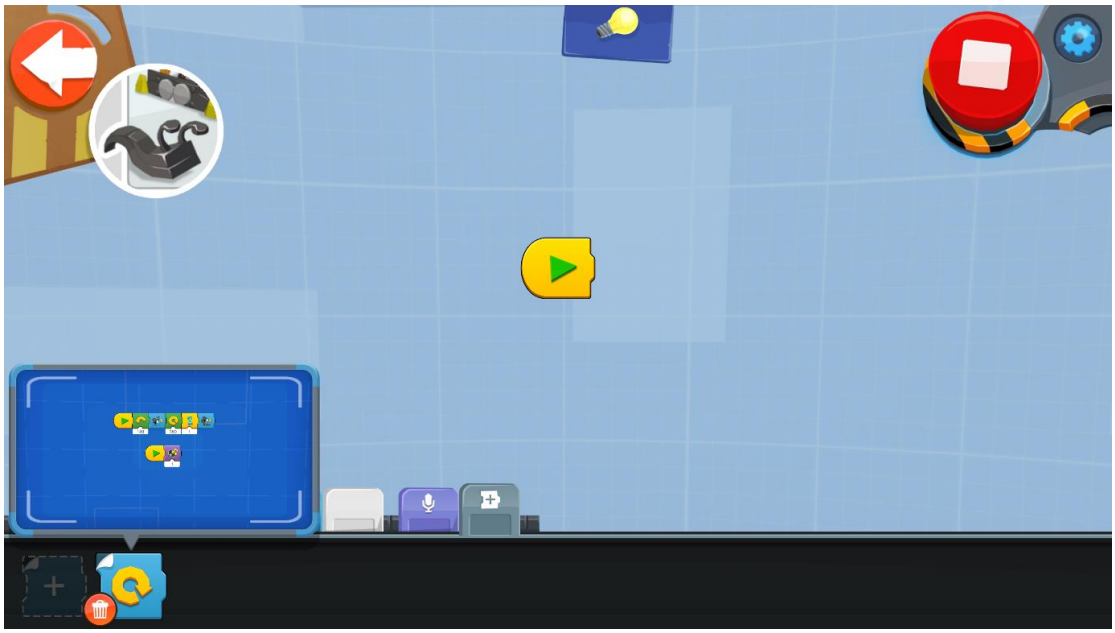


### 1.3.10 M.T.R.4 Sub-Programs

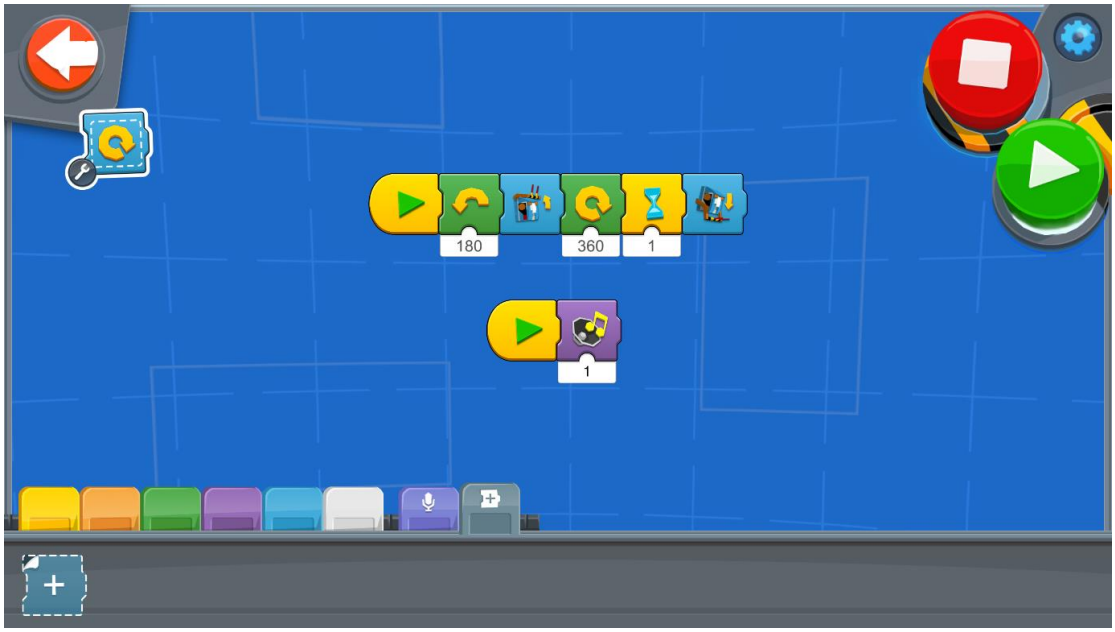
The grey section of the menu is the section of the sub programs. There, you can create a custom block and use it in your programs.

This kind of blocks are very useful when you want to use a coding block chain often. In that case, you do not need to put together all the blocks repeatedly. You just make this block chain in a custom sub-program block and use it as often as you want. With this method, your coding is much simpler and you avoid repeating yourself, which is one of the fundamental principles of programming.

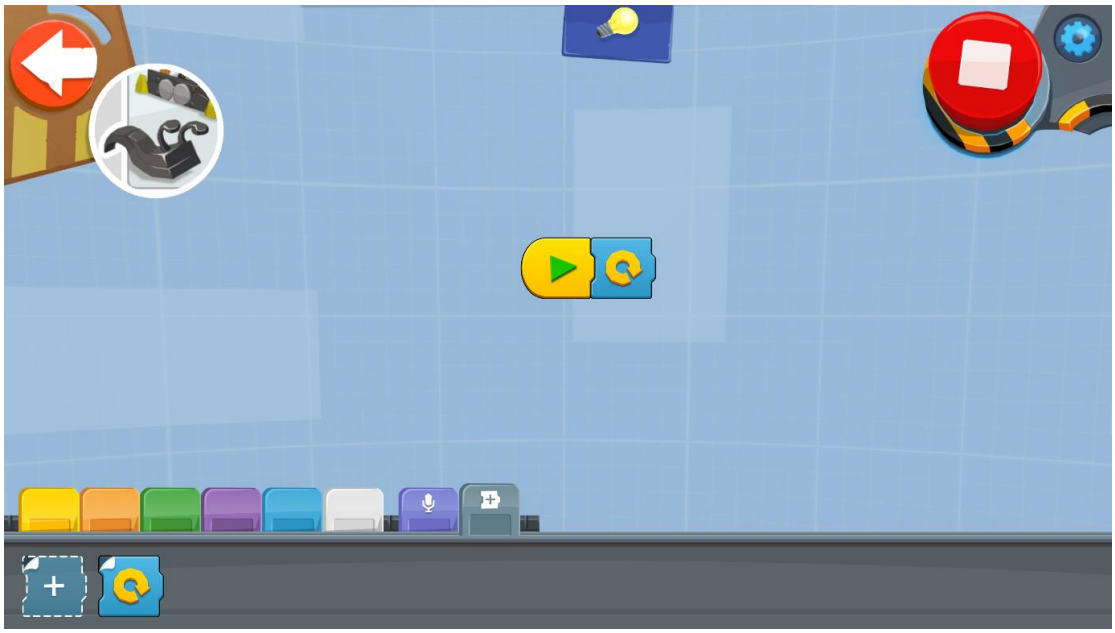




In this section, you can add a block and customize it. A dark blue background shows that you are in “customizing mode”.

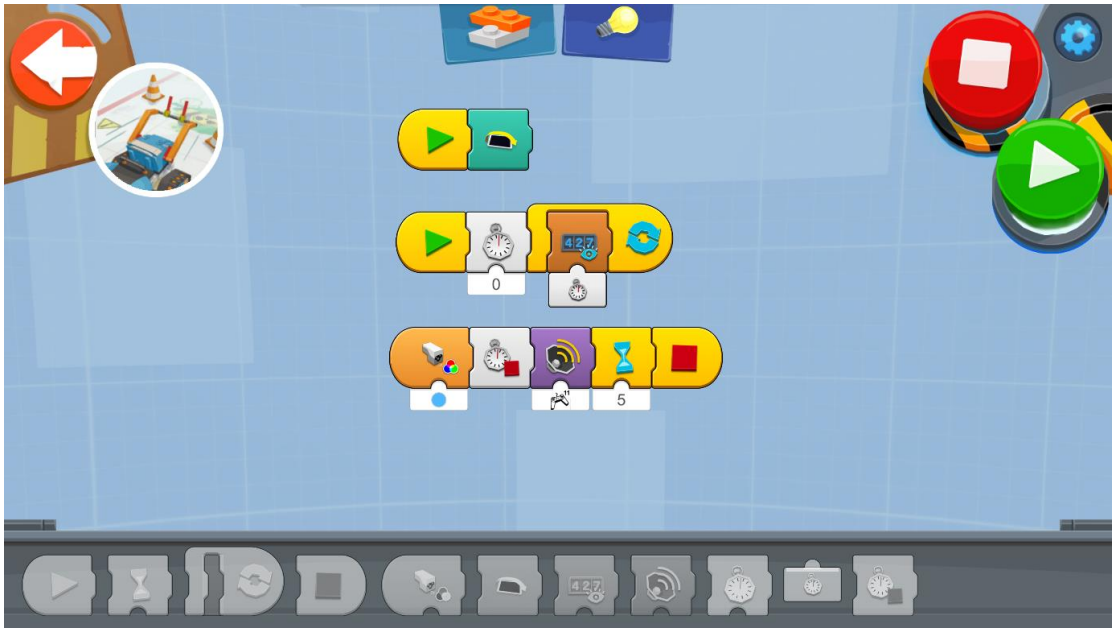



When your custom block is ready, you can find it in the grey section of the menu. It will always be there for you to use it whenever you want in your programs.



### 1.3.11 M.T.R.4 Time Your Challenges

In the orange section of the menu, you will find the display widget, which shows at the display a number. In the following program, we have used this block in order to show the timer. Pay close attention to the fact that we have to put the block inside a forever loop in order for this command to work.



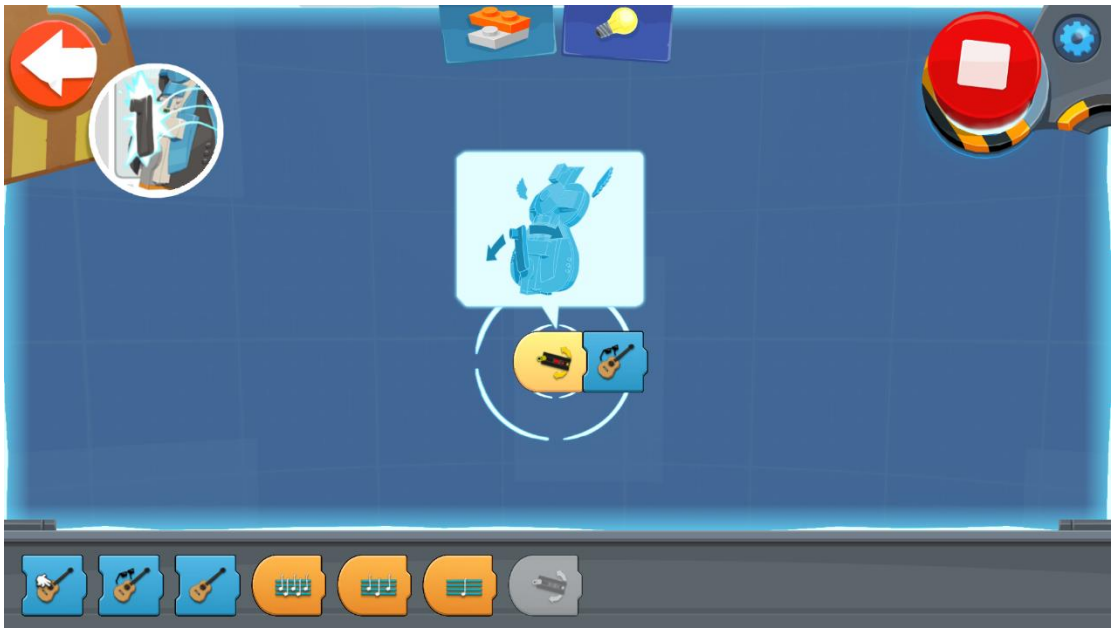
## 1.4 Guitar 4000

### 1.4.1 Guitar 4000 Automated Tempo

With these orange blocks, the Guitar plays chords automatically. The notes to be played depend on the position of the controller. Different play modes are available depending on the blue blocks used.

Try all the blocks in order to find the one you like the most!!!

### 1.4.2 Guitar 4000 Triggering Modes



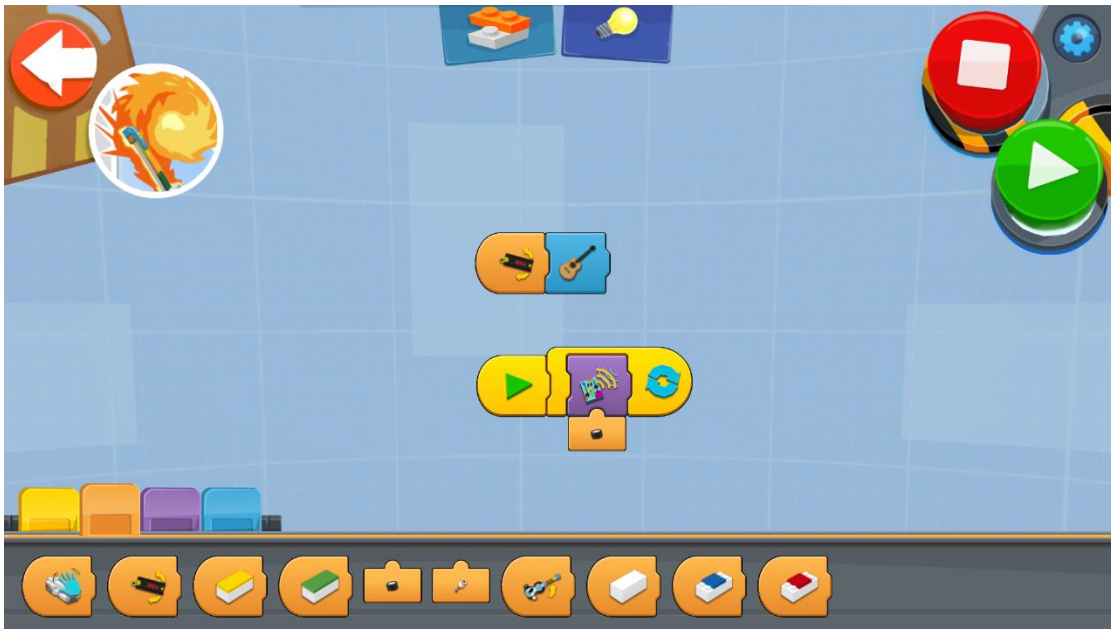
You can use your Guitar as a real one. By using the orange block shown in the pictures above you can trigger the Guitar to play several chords. As in the previous mode, you can use different blue blocks to choose the sound you like.

### 1.4.3 Guitar 4000 Assigning Different Colors to Different Sounds


Why settle for just normal guitar sounds?

If you take a close look at your guitar you will find that depending on where the slider is situated, there is a color Lego flat piece. You can assign each color a different sound by using the purple blocks. Give it a try and make your guitars' sound unique!!!

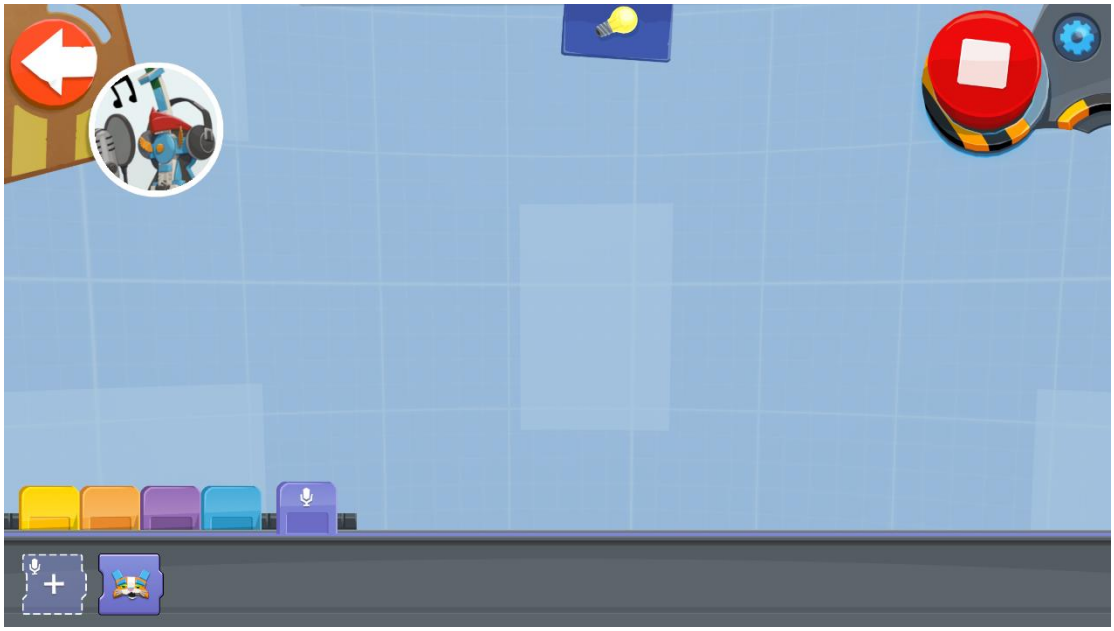
### 1.4.4 Guitar 4000 Loops and Effects



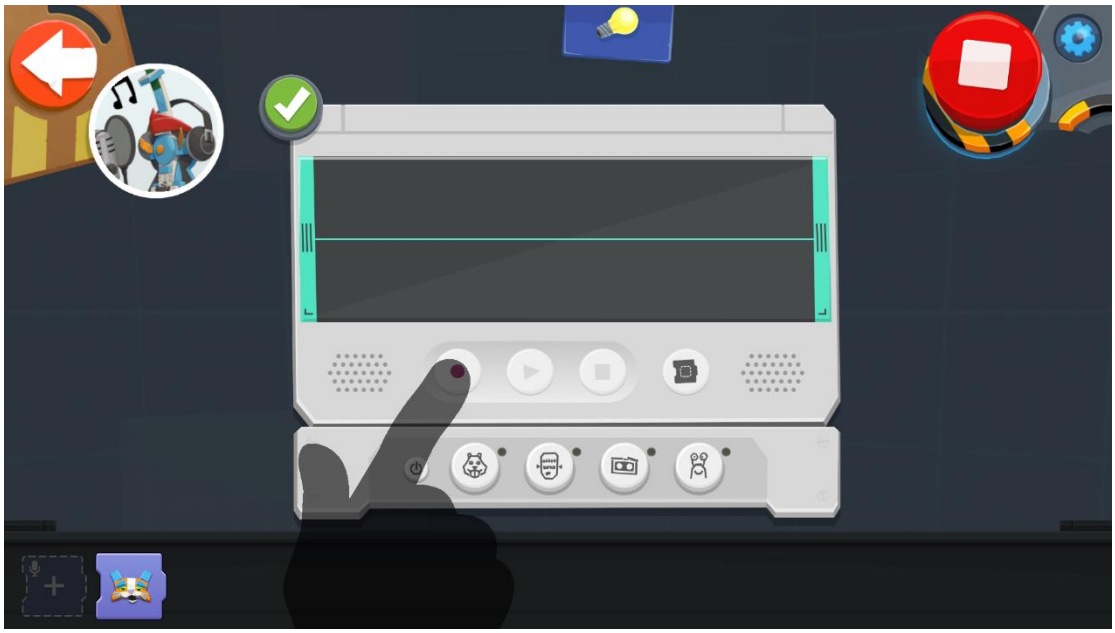
You can combine the “forever” loop with the effect blocks located at the purple section of the interface. You can use these effects with the instrument of your choice. You can also choose how the effect will be triggered and adjusted, by simply connecting the purple effect block with one of the little orange blocks, as seen in the figures above.

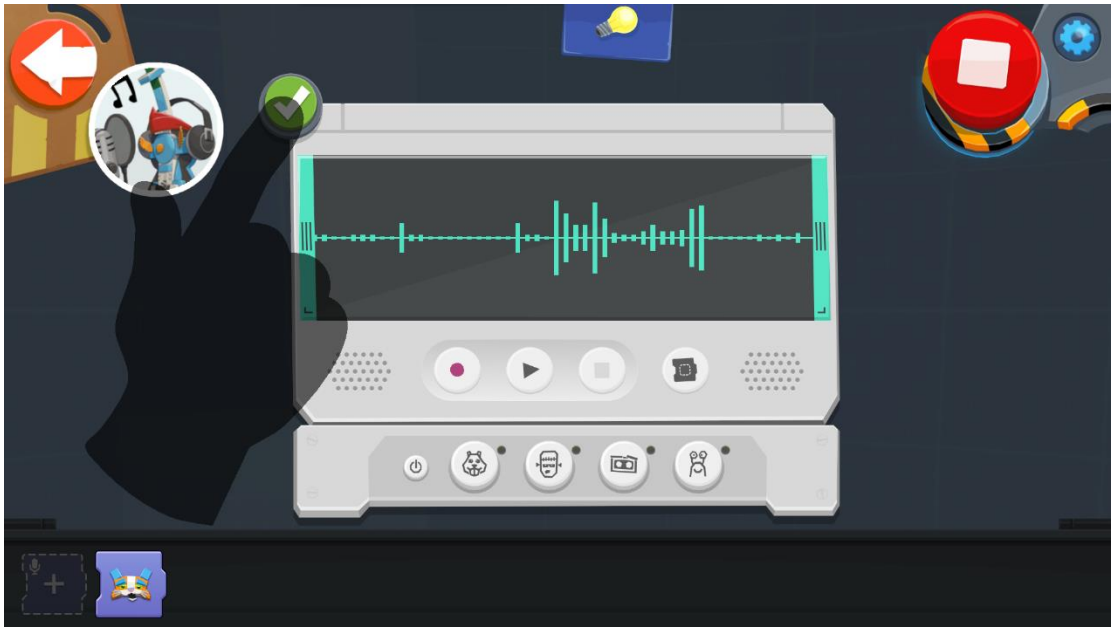
### 1.4.5 Guitar 4000 Record

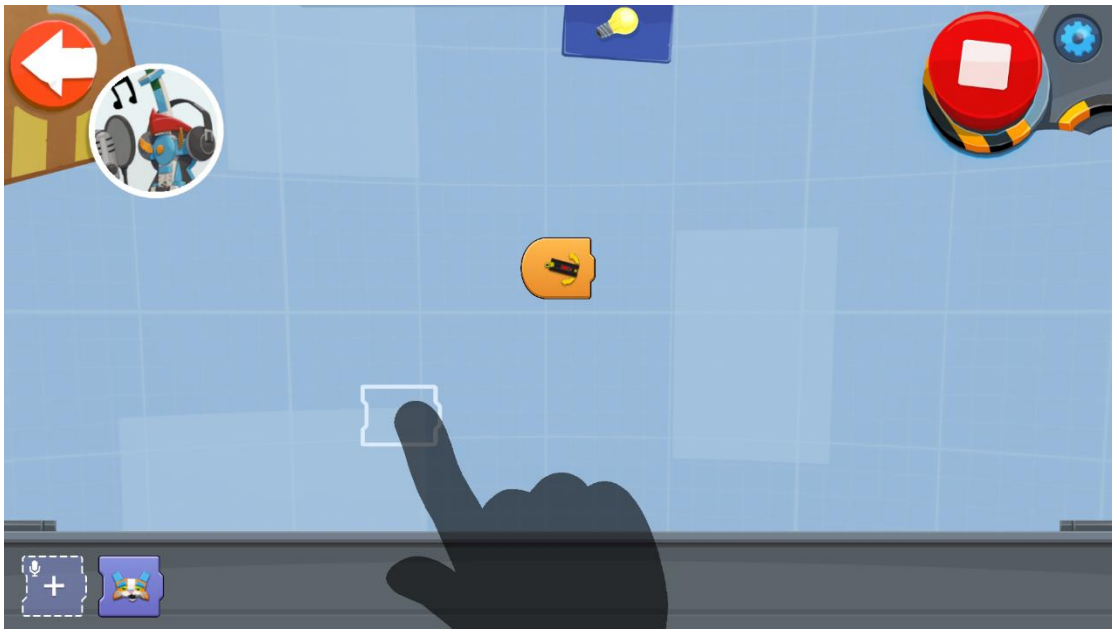
You can also record your own sound and use it with your guitar. In order to do that, you need to select the block located at the dark purple menu, as shown in the figure below.

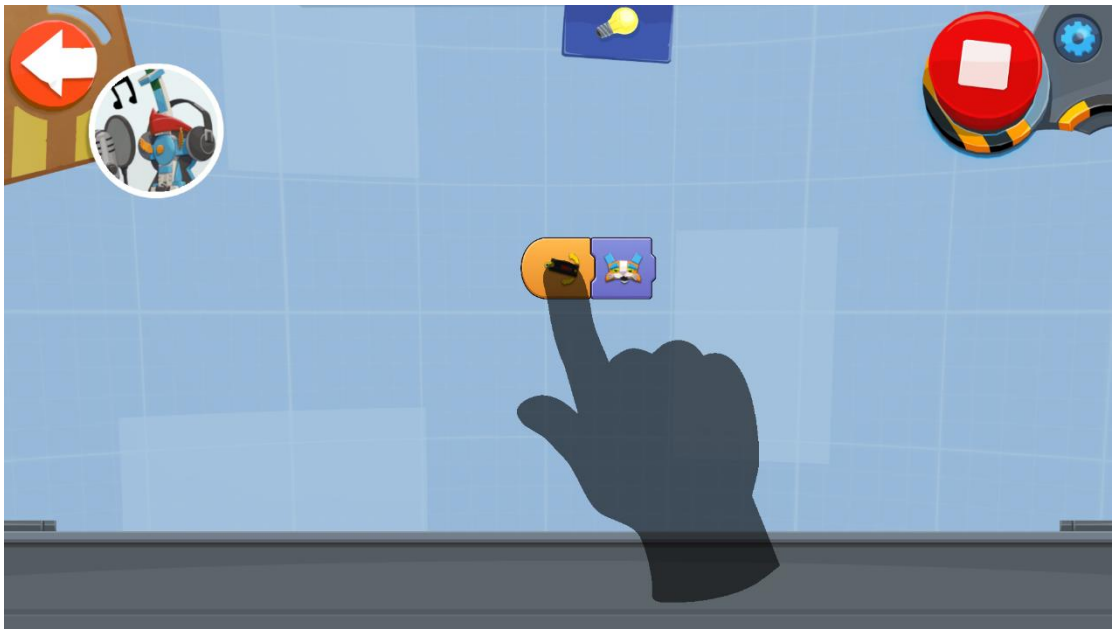


Selecting this block will activate the application in which you can record and edit a sound.



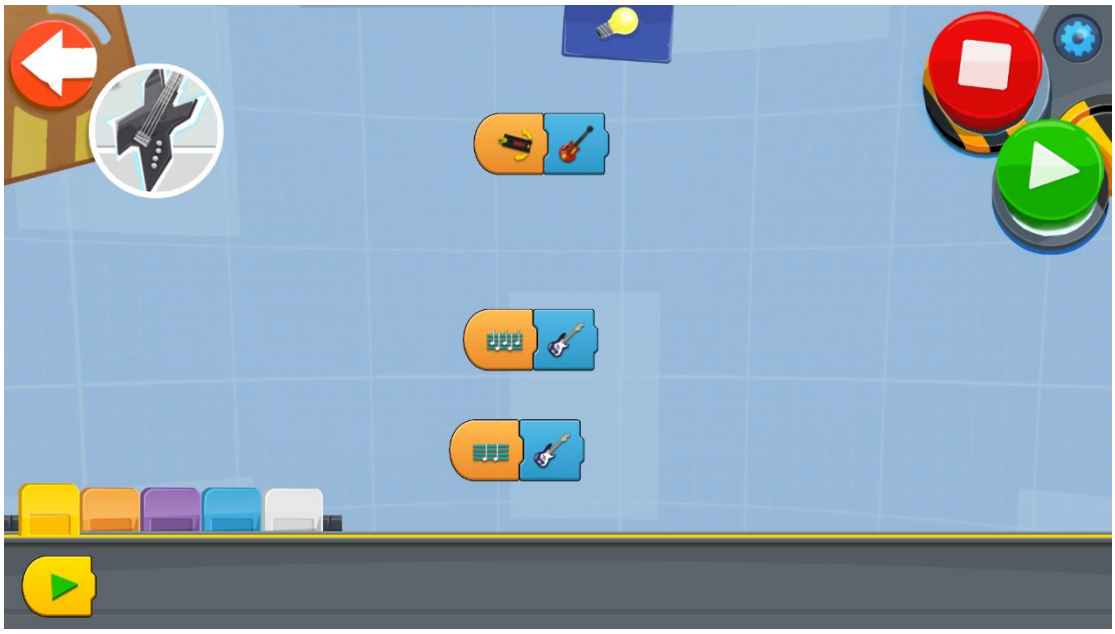






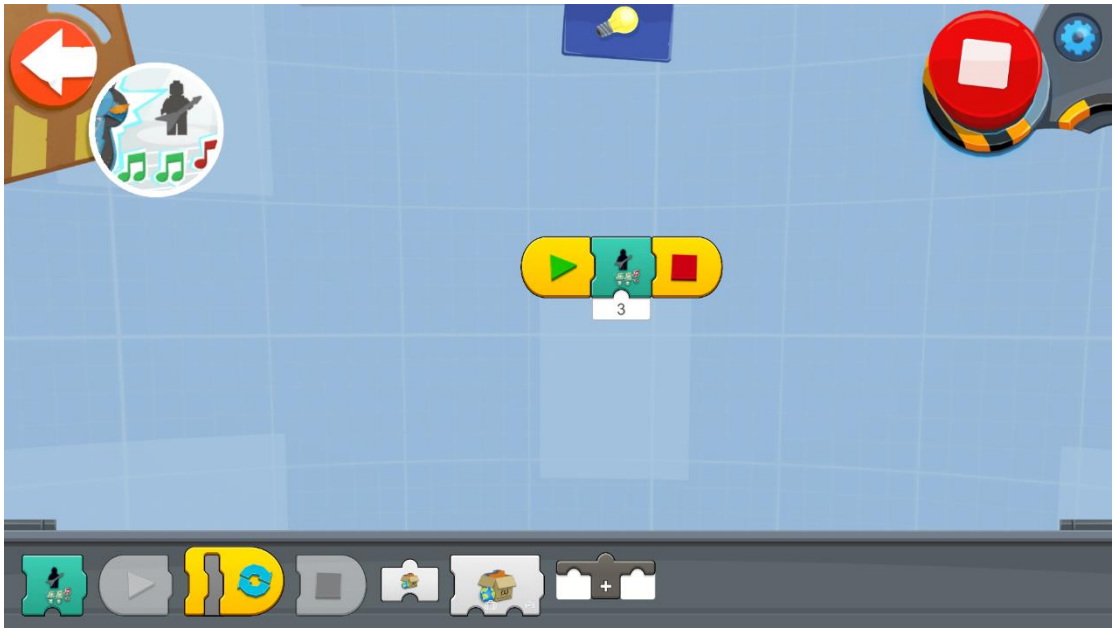
When you finally have the sound you want ready, you can save it as a new purple block, which will always be available in the sound menu to use it any way you want.

### 1.4.6 Guitar 4000 Accompanying Musical Instruments

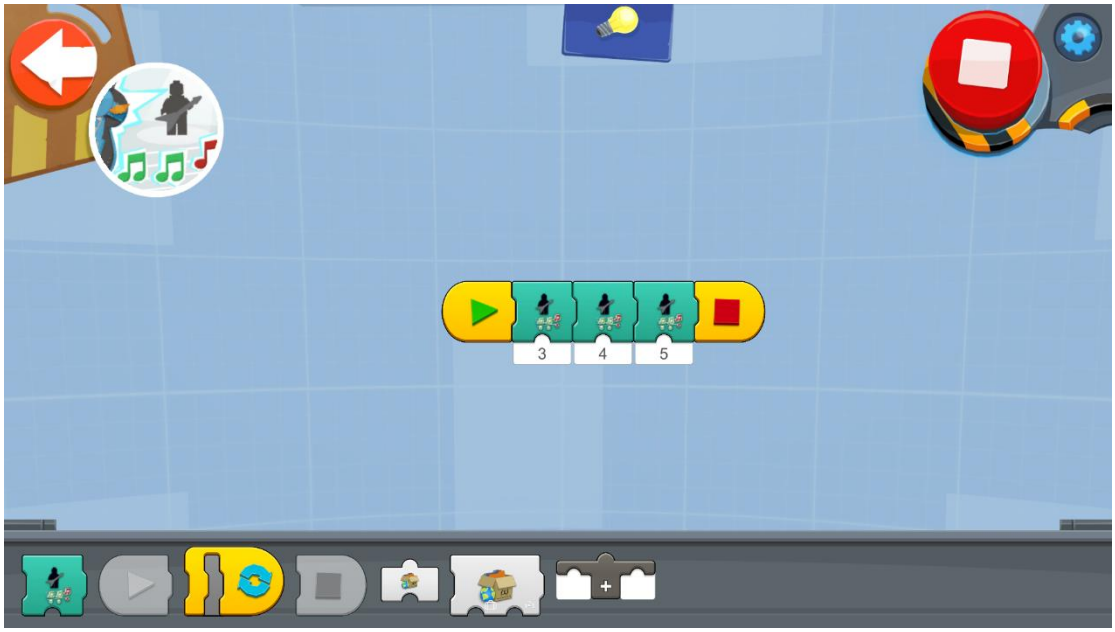



### 1.4.7 Guitar 4000 Repeat Chords Game

You can rehearse by using the following program. By activating it, your guitar will play three chords, while at the same time the guitars' led (lamp) will show the position of the slider that corresponds to each one. Then you have to repeat the sequence correctly. If you make a mistake you have to repeat the effort until you do it right.

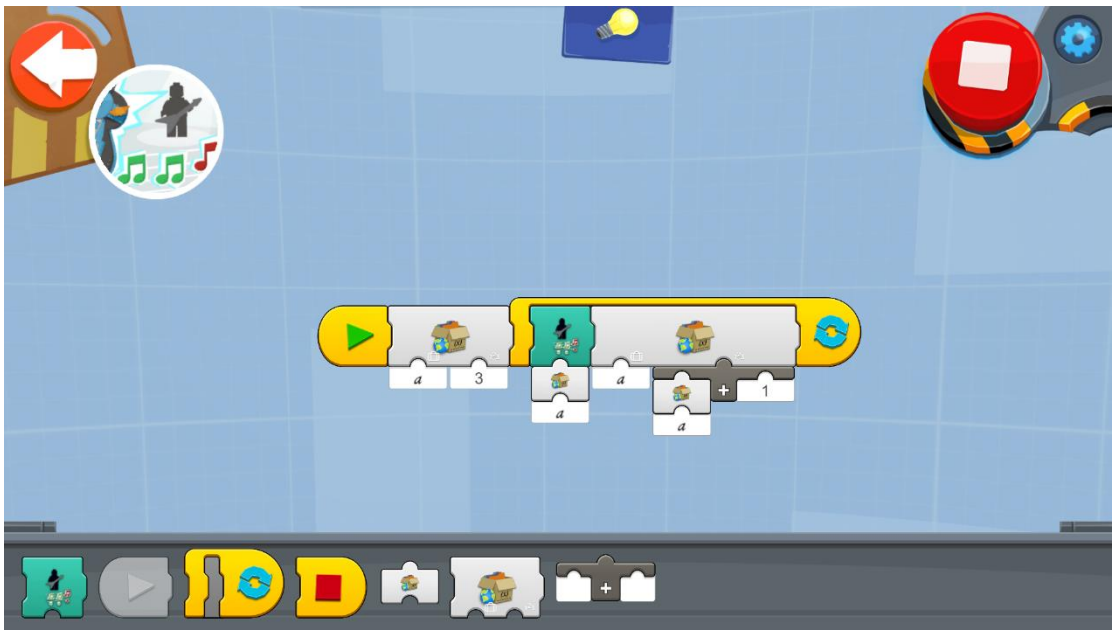



You can also use the following program to create a game in which you must be able to repeat an increasing number of chords.




With the following program, you can make a game that will automatically increase its difficulty. In this program, we use a variable to set the number of chords you need to repeat starting by 3. Then, by using a forever loop, we increase the number of chords

you need to repeat by increasing each time you succeed the value of the variable by one.



# 2. The 4 Creative Scenarios

## 2.1. History Scenario

**Title**

Talos: From the Legend to Modern Robots

**Description**

In this scenario, students will be introduced to the legend of Talos. They will construct and program a Robot just like the mythical guardian of Crete. Finally, they will discuss issues related to the protection and preservation of important cultural sites.

**Relevant Subject**

History

**Target Group**

This scenario addresses pupils of the last 3 years/classes of Primary School.

**Other Relevant Competencies**

Teamwork, Creativity

**Facilities/Equipment Needed**

For this scenario, you will need 3-4 Lego Boost kits and tablets that are compatible with them. Pupils will be divided into groups and instructions will be given to them.

**Pre-requisites**

Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the basic movements of robots, loop commands, the use of sensors, following the line programs, detecting sounds and the use of remote control.

(Chapters 1.2, 1.3, 1.4, 1.6, 1.7 and 1.8).

**Learning Objectives**

Pupils will:

- be introduced to the legend of Talos and the geomorphology of Crete
- calculate the perimeter of the island of Crete and the speed of Talos
- construct the robot
- learn simple movement commands
- get familiar with the sensors of the robot and how to use them
- develop their imagination and creativity through the construction of the robot
- develop team working skills

**Duration**

Estimated Time: 8 Teaching hours

- 2 hours for starting point (introduction), questions, drawing
- 3 hours for the construction of Vernie
- 2 hours for programming the robot and the carrying out of the assignments
- 1 hour for the completion of the assignments, video recording of the proceedings, discussion, analysis of the project and suggestions for new assignments/activities

**Theoretical Questions**

Watch this video and answer the following questions:

https://www.youtube.com/watch?v=SNg4KZKG96o&t=1s

1. How do you imagine that Talos, the robot that Zeus sent to protect Crete, would look like?

_____
_____
_____
_____

2. How fast do you think it moved?

_____
_____
_____
_____

3. If Talos moved around Crete three (3) times (Crete perimeter: 1000 km) in one day, could you calculate his speed?

_____
_____
_____
_____

4. Could he run at this speed? What other means of movement would you suggest?

_____
_____
_____
_____

**Main Activities**

**Activities:**

1. Design a robot model for Talos. Think of the features that you will give him as well as the means (equipment) it needs to protect Crete from enemies.
2. Draw a map of Crete on a big piece of paper where Talos will be placed (Draw the perimeter of the island in bold black so that the light sensor recognizes it). You can decorate it with designs from the Minoan Palaces of Knossos, Phaistos, etc.

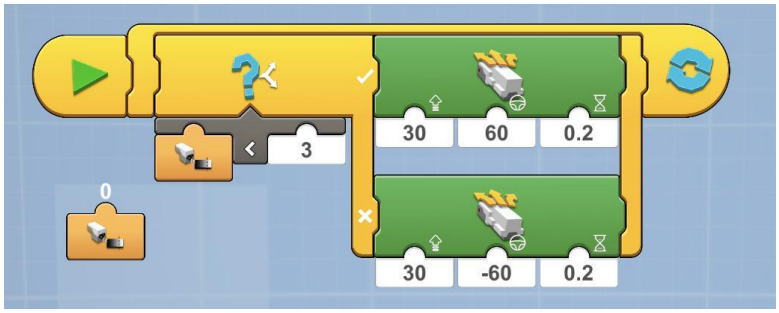
**Constructions:**

1. Construct the Vernie robot. This robot represents Talos. After you construct it according to the given instructions, you can decorate it as you would like your Talos to look like.
2. Construct enemies and ships that attack the island of Crete (both internally and externally i.e. from the sea). You can use the remaining LEGO pieces or construct them using paper.

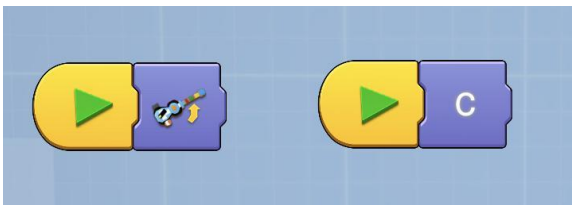
**Programming:**

1. After you have designed your own model (maquette) of Crete, calculate its perimeter using your ruler.
2. Program the robot to move on the inside of the island so that it controls and guards it with simple movement commands (approximately).

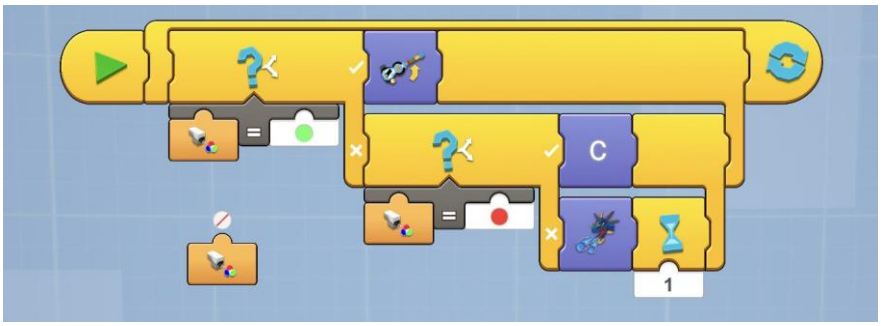

3. Remove the distance-color sensor from Vernie. Place an extension in the front of the robot where you will attach the distance-color sensor facing downwards. Program the robot to follow exactly the coastline of the island using the "follow the line" method.



4. Record the sounds: "Welcome to Crete" for friends and "Entrance is prohibited" for enemies.

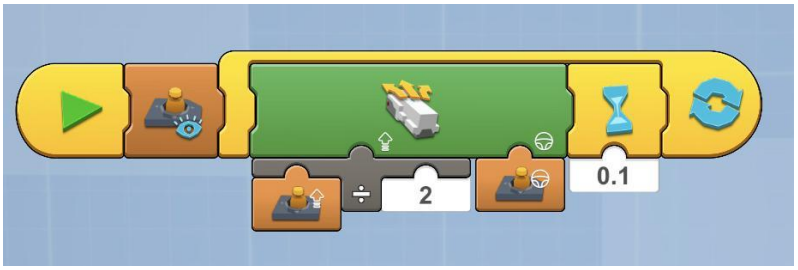



5. Using the color sensor, create a border controller as a barrier (e.g. Green color: Friend of the island, Red Color: Enemy of the island and if it doesn't see a color then he should say "Enter your password").




6. Draw or construct the Minoan Palaces of Crete (Knossos, Phaistos, Malia, Zakros). Use Talos as the tour guide who will provide useful information about the Minoan culture and who will take us to the corresponding castles.


7. Construct the Vernie robot 4.2 with the hockey stick. Place two (2) enemies anywhere inside the island. Using the remote control block, try to hit the enemies.




8. Continuing the previous mission, place the enemies again and try to create a block of commands so that the robot exterminates all the enemies.
9. Construct the Vernie robot 2.1 with the arrow launcher. Place hostile ships (which can be constructed using LEGO or any other material) anywhere outside the island, and try to hit them.

**Discussion/Conclusion**

1. Why do you think Zeus offered Talos as a gift to Minoas, the King of Crete?

2. Are there any robots nowadays that perform the same tasks as Talos?

3. Which parts of Crete would you protect, if you had such a robot?

**Further Activities**

Can you think of any new activities/assignments for Talos? Note them down and try to complete them in the classroom in collaboration with your classmates.

## 2.2. Space Scenario

**Title**

Robot from Earth to Space

**Description**

In this scenario, pupils will get to know the planets of our Solar System and program the robot in order to explore them. Finally, they will discuss issues related to space exploration, the difficulties, the changes that such an action will bring about and its impact on humanity.

**Relevant Subject**

Astronomy

**Target Group**

This scenario addresses pupils of the last 3 years/classes of Primary School.

**Other Relevant Competencies**

Teamwork, Creativity

**Facilities/Equipment Needed**

For this scenario, you will need 3-4 Lego Boost kits and compatible tablets. Pupils will be divided into groups and instructions will be given to them.

**Pre-requisites**

Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the basic movements of robots, the use of sensors, detecting sounds and the use of the remote control.

(Chapters 1.2, 1.4, 1.6, 1.7 and 1.8).

**Learning Objectives**

Pupils will:

- get to know the planets of the Solar System
- calculate the distances between them and the difficulties of traveling to another planet.
- build the robot
- learn simple movement commands
- get to know the robot sensors and how to use them
- develop their imagination and creativity through the construction of the robot
- develop teamwork skills

**Duration**

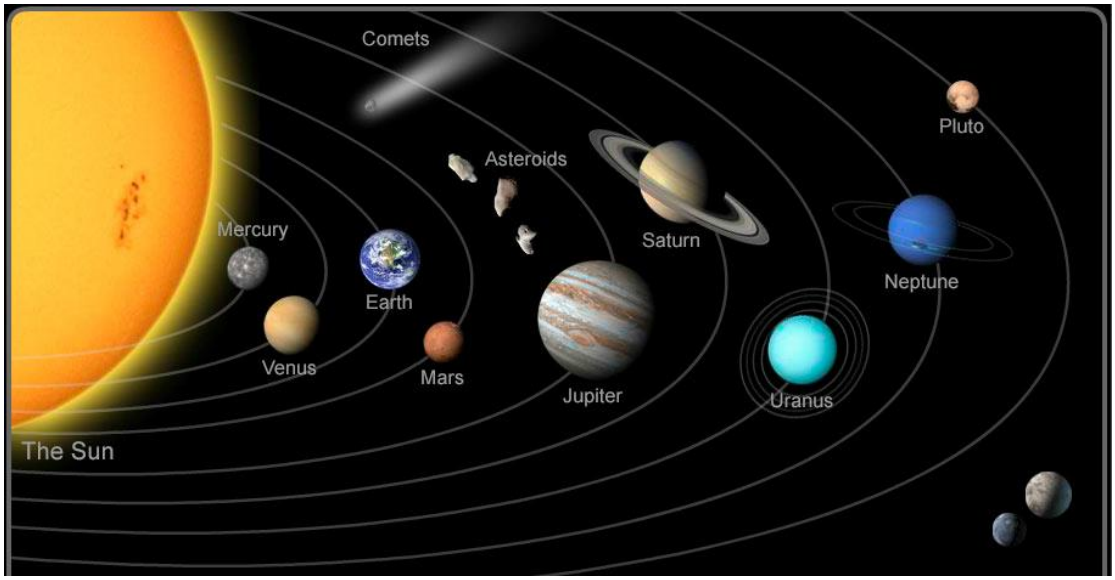
Estimated Time: 5-6 Teaching hours

- 1 teaching hour, starting point (introduction), presentation of planets, discussion.
- 2-3 teaching hours, construction of the robot.
- 2 teaching hours, programming, project analysis.

**Theoretical Questions**

Watch this video and answer the following questions:

https://www.youtube.com/watch?v=libKVRa01L8&t=36s




1. What is the difference between a star and a planet?

_____
_____
_____
_____

2. How many planets are there in our Solar System?

_____
_____
_____
_____

3. What is the largest planet?

_____
_____
_____
_____

4. What is the characteristic of Saturn?

_____
_____
_____
_____

5. Which planet is the warmest and which is the coldest in the Solar System?

_____
_____
_____
_____

**Main Activities**

**Activities:**

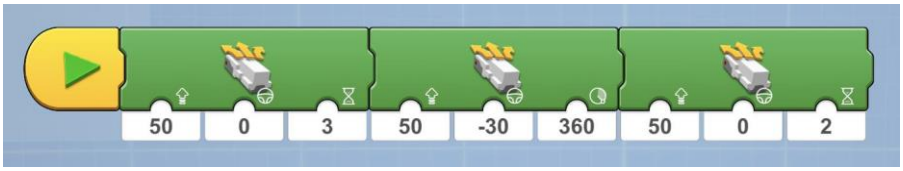
1. Design the Solar System and think of ways to make the planets you build spherical. Put them at relative distances from the Sun.
2. Draw on paper the spaceships we will send in order for the humans to inhabit other planets.

**Constructions:**

1. Build the M.T.R.4 robot. This robot will represent the spaceship. Once built according to the instructions, you can decorate it, as you would like your own unique spacecraft to look like.
2. Build asteroids and comets that will hinder the robot to reach other planets. You can use the remaining LEGO parts or make them from paper or other materials.
3. Build a satellite that the robot will fly out in order to repair during the missions.
4. Build a space-based home for Mars residents to stay.

**Programming:**

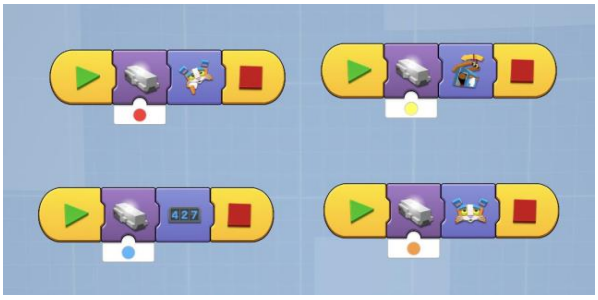
1. Once you have created the model of the Solar System with the planets, measure the distances between them with the ruler and write them down in a notebook.
2. Place the robot-spaceship on the Sun and schedule it to reach Earth.



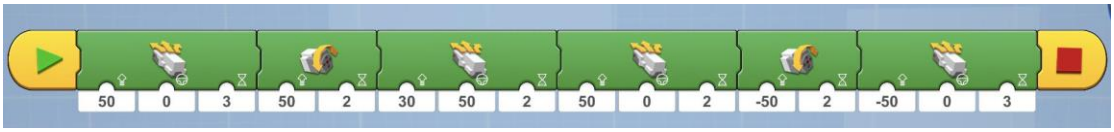

3. Put the distance sensor on the front of the robot and program it to move. When it comes across a planet program it to stop and make a sound.


4. Put the color sensor downwards and schedule the robot to follow the line that you have drawn. When it reaches Mars (red planet), make it stop and say, "I have reached Mars!!!"


5. Record new sounds for planets and depending on the color of the planet then the same color should appear in the hub.



6. Place the satellite somewhere on the model and program the robot to go towards that direction to repair it (in order to repair it the robot must grab the satellite and place it elsewhere).




7. Program the robot in order to move the “base” that humans will inhabit, from Earth to Mars.

**Discussion/Conclusion**

1. What do you think are the difficulties for humans to reach other planets?

_____

_____

_____

_____

2. If you could travel to Mars, would you like to leave Earth and live on the red planet?

3. What abilities/skills should people who will travel to Mars have in order to survive?

4. What kind of robots should we send to Mars in order to help humans (what actions should they perform)?

**Further Activities**

Can you think of any new activities/assignments for the Space robot? Note them down and try to complete them in the classroom in collaboration with your classmates.

## 2.3. Environment Scenario

**Title**

The Environmental Facility

**Description**

Students aged 9 to 12 learn about the environment and the importance of sorting the waste that humans create. The Swedish National Agency for Education declare in the syllabus for grades 4-6 the following formulation as a steering document for teachers:

Nature and society

"Human dependence on and influence on nature and what this means for sustainable development. Ecosystem services, such as degradation, pollination and purification of water and air."

The students will build the robots Vernie and M.T.R.4 for inspiration and use them in different activities concerning the scenario environment.

**Relevant Subject**

Biology, Social Sciences

**Target Group**

Students aged 9-12 (Grades 4-6)

**Other Relevant Competencies**

Teamwork, Creativity

**Facilities/Equipment Needed**

For this scenario, you will need 4-6 Lego Boost kits and compatible tablets, depending on the number of students in the class. You will need an extra for the teacher. Pupils will be divided into groups and instructions will be given to them. Preferably gender mixed groups.

**Pre-requisites**

Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the basic movements of robots, loop commands, the use of sensors, detecting sounds and the use of the remote control.

(Chapters 1.2, 1.3, 1.4, 1.6, 1.7 and 1.8).

There are also general education prerequisites: Students should be able to understand what recycling means, how people recycle and what is the expected impact. Students may make a study visit to the local recycling station.

**Learning Objectives**

The students will:

- be introduced to the recycling scenario
- construct the Robot
- learn simple movement commands
- get familiar with the sensors of the robot and how to use them
- develop their imagination and creativity through the construction of the robot
- develop team working skills
- learn about recycling stations and how waste products are transported to the station

**Duration**

Estimated time for the scenario will be 540΄

- Student΄s study visit to the local environmental station, 120΄
- Two groups building Vernie, 120΄
- Simultaneously two groups building M.T.R.4, 180΄
- Programming the robots, 120΄
- Activities such as sorting waste products, 60΄
- Finalizing the scenario 60΄

**Theoretical Questions**

1. How can household waste be reused in a good way?

   _____
   _____
   _____
   _____

2. How can we humans change our way of life so that we reduce the use of the earth's resources?

   _____
   _____
   _____
   _____

**Main Activities**

**Activities:**

1. Let the students work in groups (mixed gender if possible) and have the students construct a recycling center. Remember to create the logistics in the form of access roads, landfills and plants to create biogas. Students can build the recycling centre by using different materials, for example papier mache. Buildings and plants can be constructed of cardboard or Lego building blocks. The landfills can be built from different types of fabrics. The roads in the facility should be designed so that the

vehicles move without risk of contact with each other. There should be separate collection areas depending on the type of waste.

2. Program the robots so that they move forward, backwards and can swing in either direction.

**Constructions:**

Build the robots Vernie and M.T.R.4.

Vernie will act as an information center at the environmental facility. He should be able to utter where the vehicles should deposit their waste.

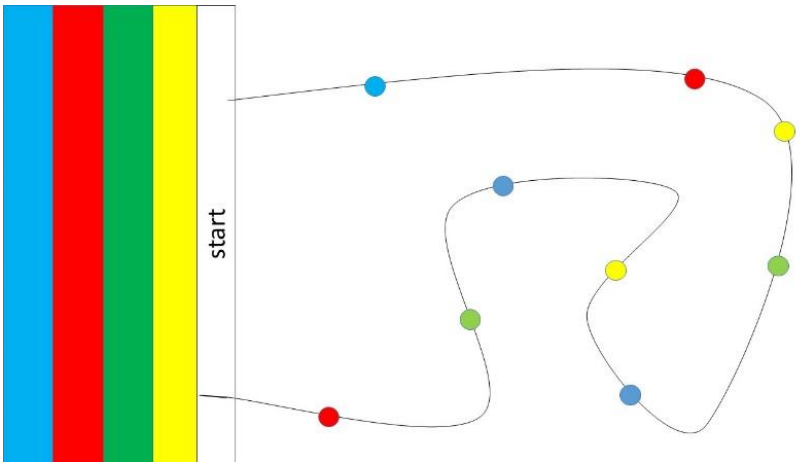
M.T.R.4 shall represent different types of vehicles that are present at the Environment Center, such as trucks, tractors and passenger cars with trailers.

**Programming:**

Vernie will be programmed to use color sensors to distinguish between different types of rubbish. Combustible waste can be stained yellow. Waste to be deposited is stained orange. Material that can be reused, such as plastic will be stained red, glass will be stained blue and paper will be stained green.

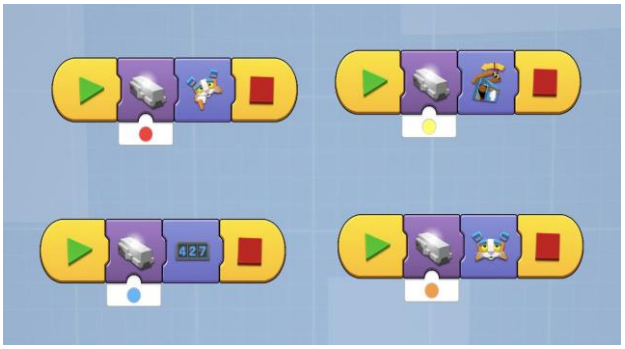
1. Remove the distance-color sensor from Vernie. Place an extension in the front of the robot where you will attach the distance-color sensor facing downwards.

2. Prepare a line or a track across the road, which the robot can follow and locate the waste.




The play mat should look like the picture above. The robots must start from the start area.

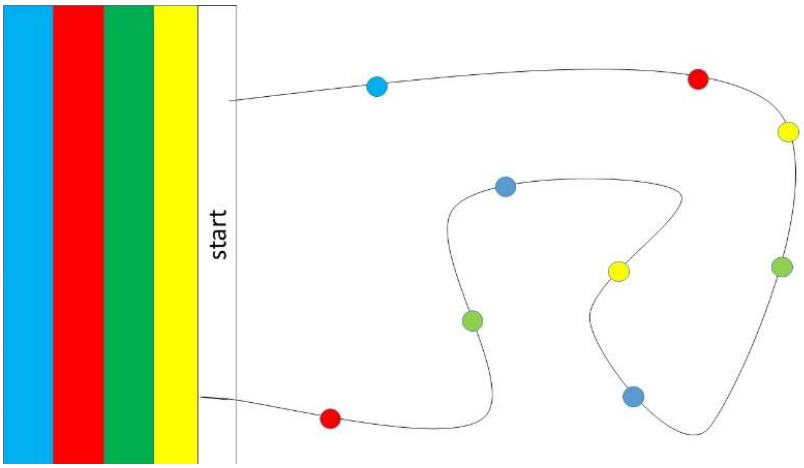
3. Record new sounds for different types of rubbish (Combustible waste, waste to be deposited, etc.)



4. Program the robot to follow the line you have drawn across the roads and identify any waste it finds. When Vernie identifies something, he should shout the type of waste he has found.


M.T.R.4 will be programmed to follow the road and dispose of the rubbish.

5. Prepare a road or a track where the robot M.T.R.4 can fetch and deliver waste.




(The play mat should look like the picture above. The robots must start from the start area.)

6. Program the color sensor to pick up plastic (red).

7. Program M.T.R.4 to lift the plastic.

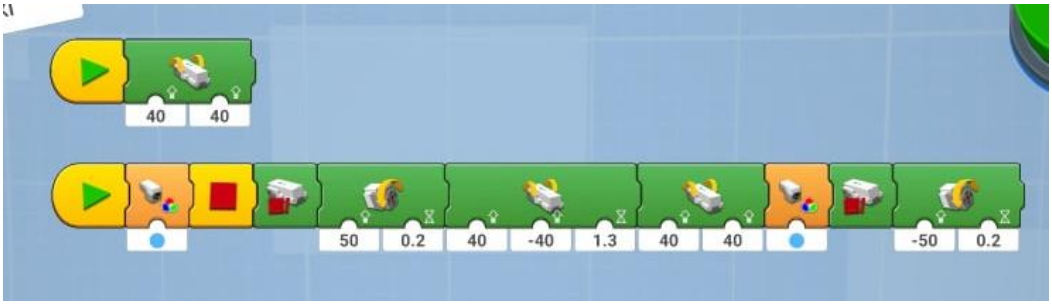
8. Program M.T.R.4 to leave the plastic at the red area.


(The robots must start from the start area and in line with the waste that we want to pick up and transfer to a specific area.)

9. Program the color sensor to pick up glass objects (blue).

10. Program M.T.R.4 to lift glass objects (blue).

11. Program M.T.R.4 to deliver the glass objects to another location this time (blue area).




12. Program M.T.R.4 to retrieve paper (green) and deliver it to a specific location (green area).


13. Program M.T.R.4 to retrieve waste (yellow) and deliver it to a specific location (yellow area).


**Discussion/Conclusion**

1. Research has shown that man contributes to soiling nature. How can we state with our senses that this happens?

   _____
   _____
   _____
   _____

2. How can we prevent pollution of the seas?

   _____
   _____
   _____
   _____

**Further Activities**

Have the students make their own biogas by blasting and applying heat.

## 2.4. Culture Scenario

**Title**

Form your own Robot Guitar Band!

**Description**

We want our students to make a simple melody by building the robot Guitar. We intend to find out what the possibilities of the Robot Guitar are. Can the students create and play a simple tune with the help of the Robot Guitar? Can we add rhythm instruments to support the melody loop? Can we find chords that fit the melody loop? Is it possible, with the help of the guitar, to arouse interest in the origin of music and how people created simple instruments that then evolved into what we today recognize as modern musical instruments? Can the Robot Guitar stimulate students' curiosity for increased knowledge of today's synthetic music?

We also want to investigate how folk music originated. The Sami people in northern Europe have their own, special way of singing - the Joike. Here are two examples of Joiks:

Song 1 | Song 2

**Relevant Subjects**

Mathematics, Music, History

**Target Group**

Primary School Students aged 9-12 (Grades 4-6)

**Other Relevant Competencies**

Creativity, Teamwork, Develop knowledge about Music history, Develop knowledge about Musicality.

**Facilities/Equipment Needed**

For this scenario, you will need 4-6 Lego Boost kits and compatible tablets, depending on the number of students in the class plus an extra for the teacher. Pupils will be divided into groups and instructions will be given to them. Preferably, gender mixed groups.

**Pre-requisites**

Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the use of sensors and detecting sounds. (Chapters 1.4 and 1.7).

Students should have basic knowledge of note learning. What does the C major scale look like?

Students should also know about the regional folkmusic in the area and traditions connected to the music.

**Learning Objectives**

Students learn about:

- the history of musical instruments. They see the connection between The Robot Guitar and modern synthetic music
- notes, minor and major chords
- folk music in different countries

**Duration**

Music/Culture scenario, 480 minutes

- Building the Robot Guitar, 180 minutes
- Programming the Robot Guitar, 120 minutes
- Music history, Folk music 180 minutes

**Theoretical Questions**

1. Make a list of different types of music.

   _____
   _____
   _____
   _____

2. What is sound?

   _____
   _____
   _____
   _____

3. How do you get instruments to sound different?

   _____
   _____
   _____
   _____

**Main Activities**

**Constructions:**

1: Build the Robot Guitar 4000

2: Investigate what sounds you can get out of the guitar

**Activities:**

Step 1: Inform the students what the different notes correspond to on the guitar.

Step 2: Show students the notes that apply to the simple tune we have chosen. Suggest a melody that children in different countries know, for example Brother John.

Step 3: Students get to code the guitar tone by tone by moving the "finger" on the guitar's neck so that the simple melody appears. It becomes a form of analog programming.

Step 4: Teach students to distinguish between major and minor chords. Train them to code the chords.

Step 5: When the student has learned how to play the simple melody, a friend may be given the task of finding the simple chords that fit the melody.

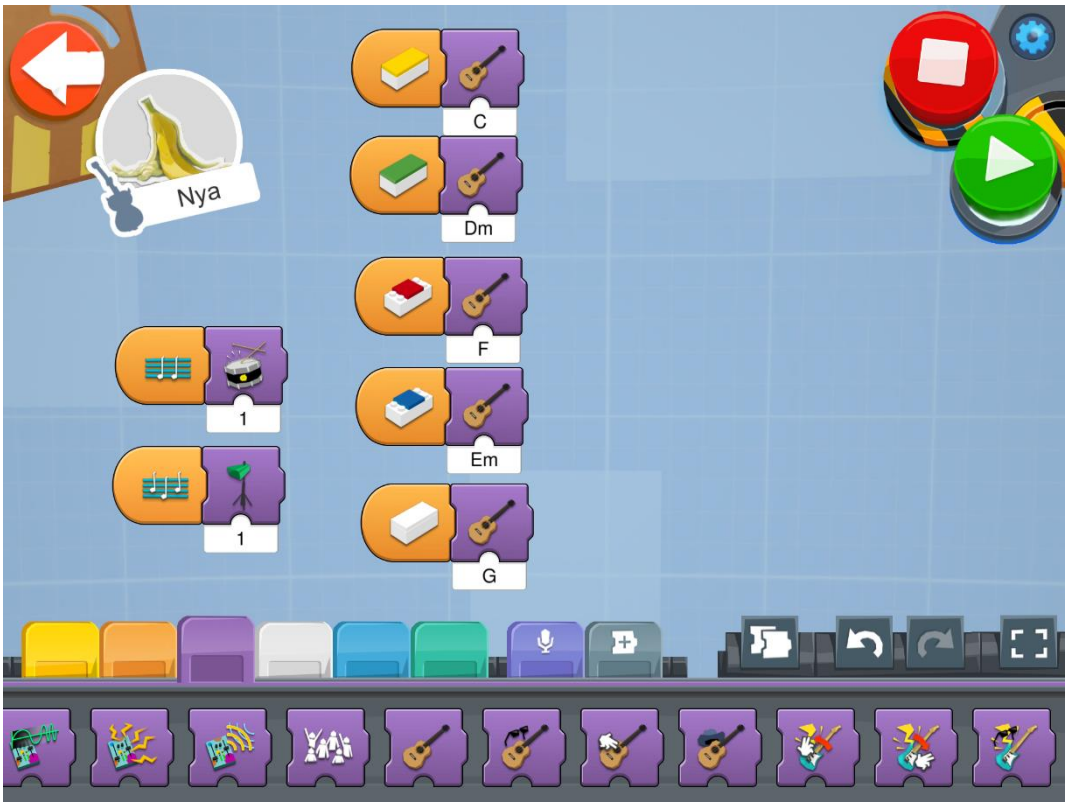
Step 6: Have the students use the violin sound on the robot, as violin is the most common instrument in Swedish folk music.

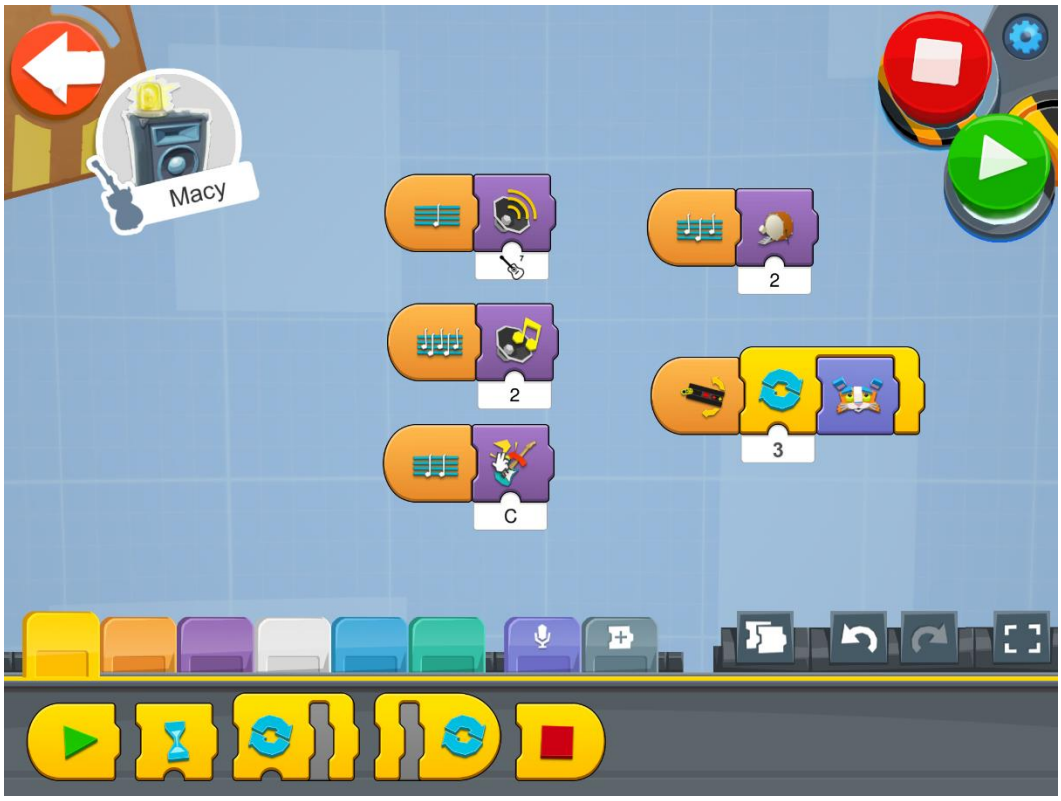
Step 7: The students code the robot to play the melody on a well-known folk song, for example Hårgalåten.

**Programming**

1. Start a discussion how to create a simple melody. What does it contain? Listen to melodies and use them to find different parts in the melody: intro, verse, chorus and outro, tempo and pulse.

2. Find out the possibilities that the Robot Guitar 4000 provides. What can it sound like? What instruments can it imitate? Give instructions concerning programming functions: Start blocks, loops, instruments, the instruments' different notes and chords.




3. The students will now code the Robot Guitar to create and play their own simple melody. The setting should contain:

- A lead guitar that plays the melody
- A background beat / rhythm that is looped and repeated
- An instrument that plays a chord loop with at least two different notes / chords.

**Discussion/Conclusion**

1. Why is music featured in many movies?

   _____
   _____
   _____
   _____

2. List different kinds of dances.

   _____
   _____
   _____
   _____

**Further Activities**

Divide the class into four groups.

Group 1 is given the task of finding out what is meant by folk music. The group can make a presentation and play examples of folk music.

Group 2 defines what is called classical music and plays an example of classical music.

Group 3 tells about music played during the 60's and plays a song of the Beatles.

Group 4 finds out what is meant by synth music and plays a piece of a well-known synth group.