

## Introduction

Dear friend,

My name is Alex and I invite you to travel with me to a mysterious island where we will face interesting challenges. Together we will solve real life problems, while trying to survive in the island.

Among other models, we will build a propeller plane to take us to the island, a carousel to have fun, a radar to detect unknown creatures, a smart house to use it as a shelter and a wind turbine to produce electrical energy.

Within the pages of this book we will study the core subjects of STEM (Science-Technology-Engineering-Mathematics) and Robotics while constructing robotic models using the controller and sensors.

Collaborate with your friends and use your imagination and ingenuity in order to find the best solutions to solve the problems of each lesson!

This book belongs to:

.....  
.....  
.....  
.....

Your Photo



## Contents



- 03** **Episode 1:** Life in the village
- 09** **Episode 2:** A fun park adventure
- 15** **Episode 3:** A wish comes true
- 21** **Episode 4:** Operating a radar







## Episode 1: LIFE IN THE VILLAGE

ALEX LIVES IN A COUNTRY WHERE MANY WINDMILLS EXIST!! BUT, ONE DAY A HURRICANE ARRIVED ...



## Activities



Hi, my name is Alex and I live in a village with many windmills! One day a hurricane arrived and all the locals of my village were very disappointed, because a windmill had broken. I had an idea of creating new blades using Engino parts. The next day, my friends and I repaired the blades.

Do you want to help Alex fix the windmill?

### Familiarizing with Engino Toy System

The construction of the model will be made with Engino components. Before you start building, you should find the basic parts and the robotic components of the Engino system. Make your own constructions by using the **different connections** and **combinations** of the **basic parts**.

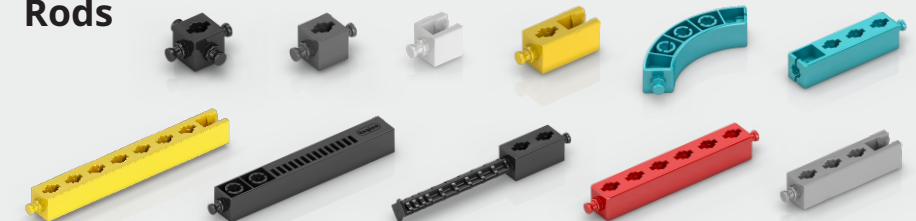
#### Cubes



#### Stripes



#### Rods



#### Angles



#### Wheels



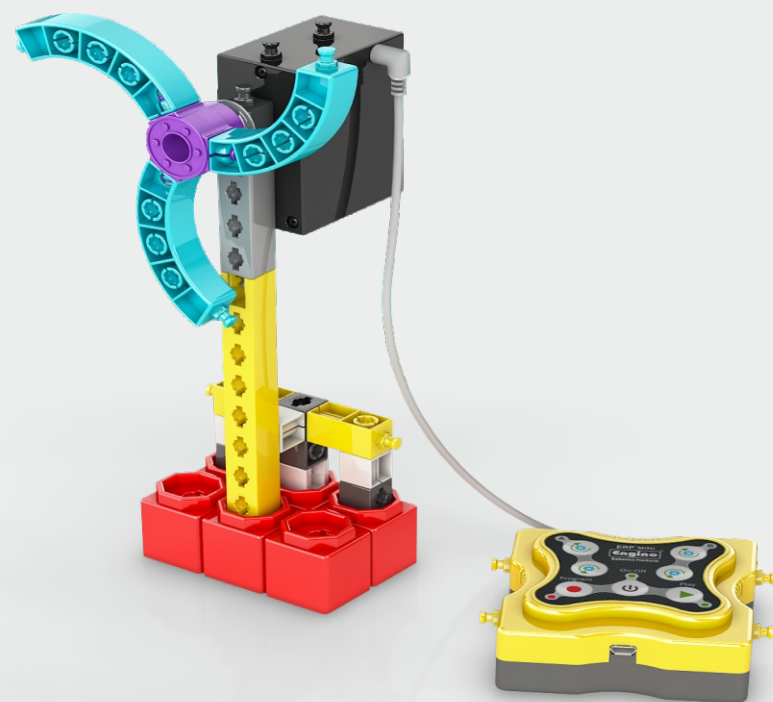
#### Robotic parts





## Build

Build the “Windmill” model with your team.





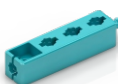

## Challenge 1

Place 3 AAA batteries inside the MINI controller and press the On-Off button to switch it on. After that, press all the other buttons to learn their use.



## Conclusion

Engino parts have many different colors and shapes. Count the number of the shown parts that exist in the package and complete the table below.

|   |   |   |   |
|---|---|---|---|
|  |  |  |  |
|   |   |   |   |



## Theory

### Life in a village

In the past, people did not have the necessary materials so as to build more complex constructions. Therefore, people were obliged to find solutions to their daily problems out of what existed in the village. For example, it was very important to find new ways for acquiring valuable resources like food and water. That is how the discovery of the windmill came into light.

### Windmills

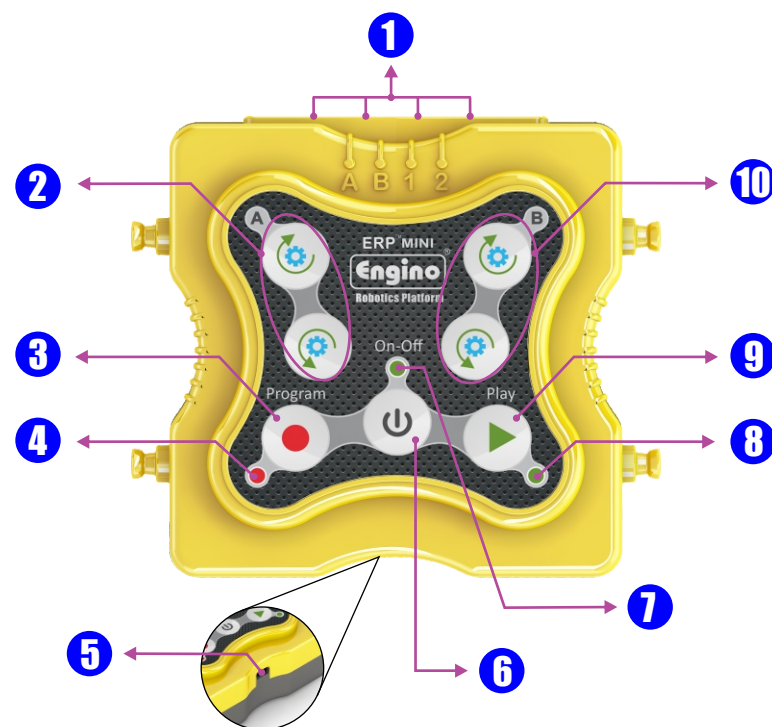
In antiquity, windmills played a significant role in people’s life since they were used for grinding cereals and for pumping water. They were built with stones and had a cylindrical shape. The operation of the windmills was based on wind energy, thus they were built at windy spots. The windmills could grind 20-70 kg of grain per hour depending on the intensity and direction of wind.



A country famous for its windmills is the Netherlands in Europe. Once you visit the Netherlands, you will be impressed by the beautiful windmills and the colorful valleys. Dutch windmills were mainly used for pumping water out of the lowlands and send it back to the rivers, in order to cultivate the land.

## MINI controller

The Engino® MINI controller is a robotic device consisting of a main controller, a variety of buttons and indicators. Through the 4 ports of the device, a variety of peripherals can be connected such as motors, LED, InfraRed and touch sensors. The MINI controller is a powerful, flexible and easy to use tool.



**1 A,B,1 and 2 RJ PORTS**  
connect peripherals to the controller

**2 MOTOR A BUTTONS**  
clockwise or anticlockwise

**3 PROGRAM BUTTON**  
records a sequence of commands

**4 PROGRAM LED**  
flashes while recording

**5 mini USB PORT**  
connects the controller to a PC

**6 POWER BUTTON**

**7 ON/OFF LED**  
turns on when controller is ON

**8 PLAY LED**  
turns on while playing a program

**9 PLAY BUTTON**  
runs the stored program

**10 MOTOR B BUTTONS**  
clockwise or anticlockwise

## Did you know?

Holland celebrates the "National Mills Day" every second Saturday and Sunday in May. It is an annual festival and on that day more than 900 mills open their doors to visitors.

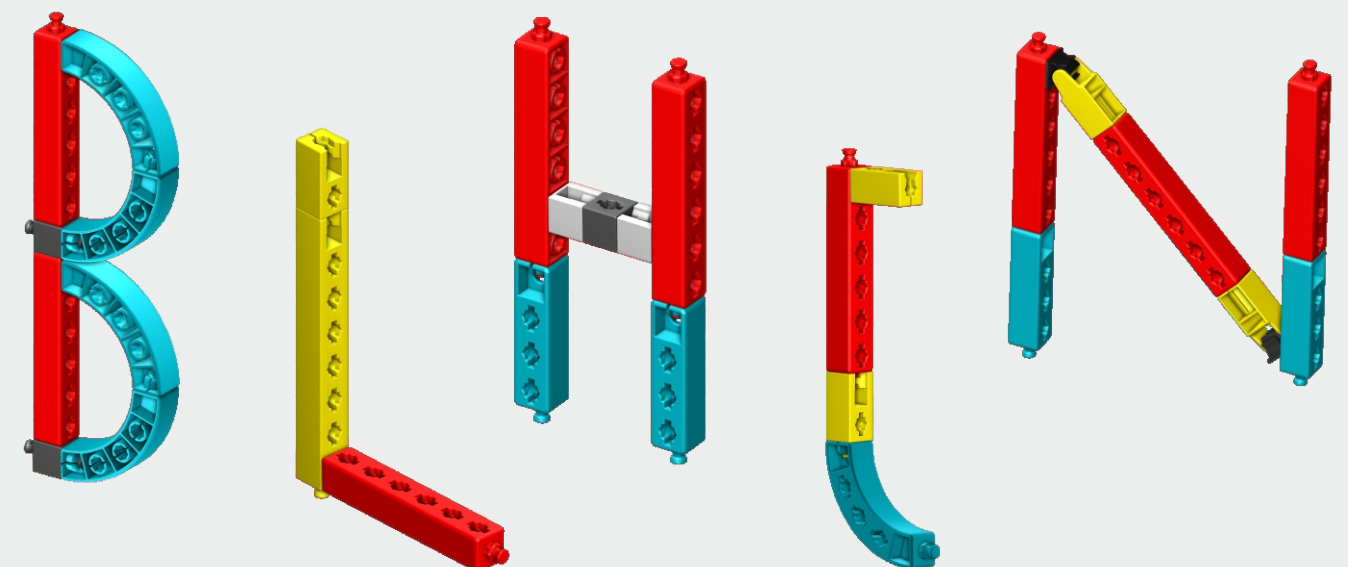


People who visit Holland those days, would have the chance to see mills decorated beautifully with flags and flowers. Tourists may have a tour into the mill and find out more about their history and the purpose each mill serves. Other may be lucky enough to even help the miller at his job! This is a fantastic opportunity to get inside a windmill or a watermill and learn about its history.



## Extra Challenge

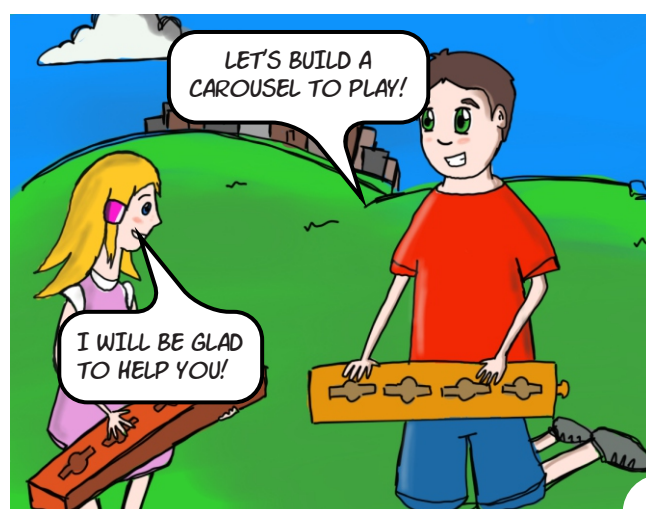
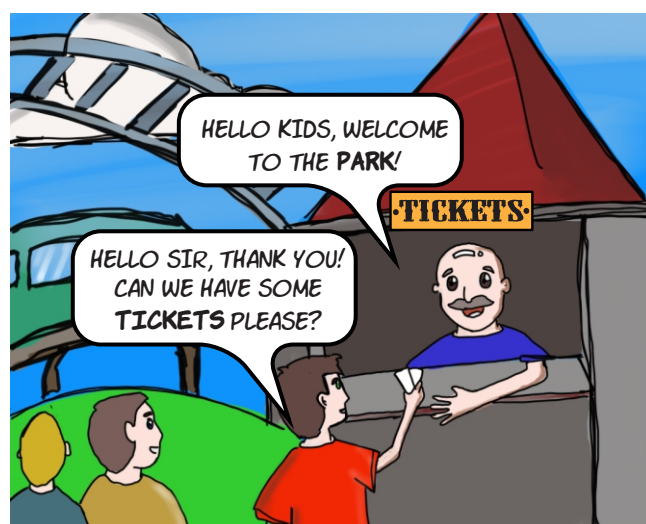
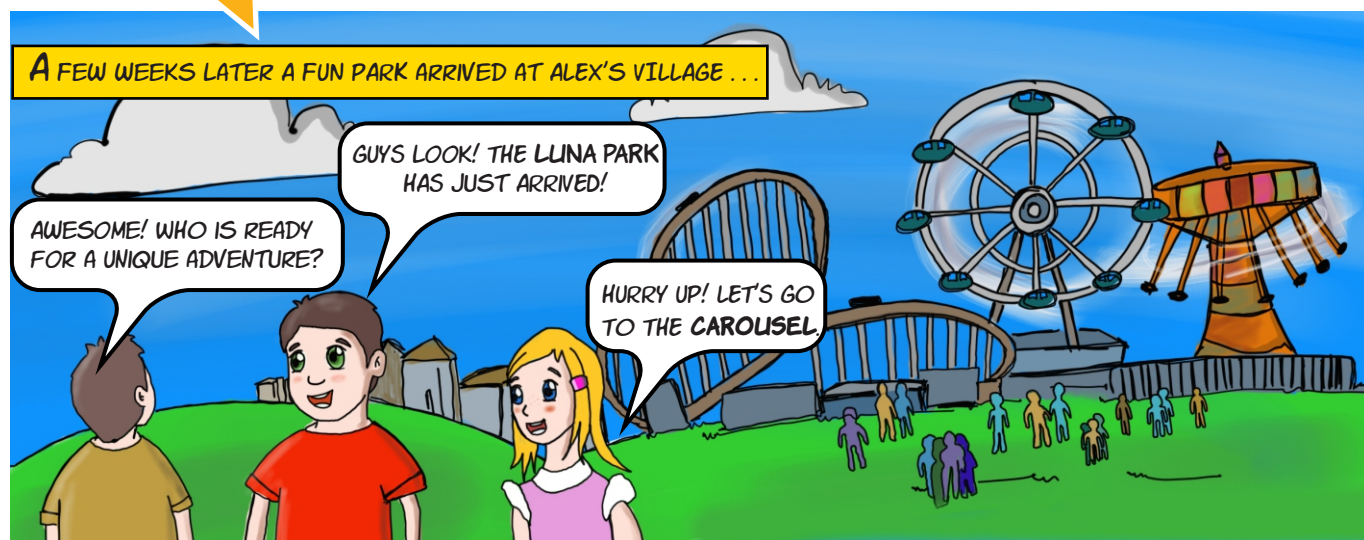
Create the first letter of your name using Engino parts. You may get some ideas from the examples below.



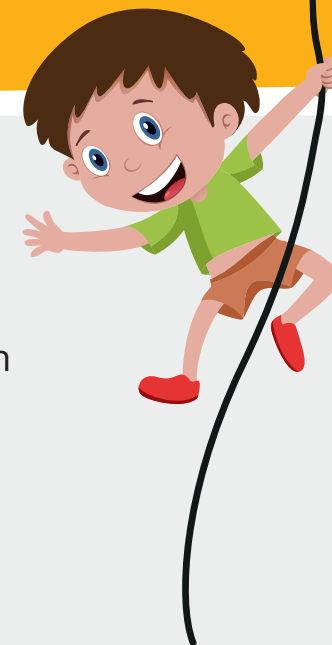




## Episode 2: A FUN PARK ADVENTURE



## Activities



When I was in the Luna Park, I went to the big carousel. It was my favourite game! Without any hesitation I stepped into it to have some fun. Unfortunately, the Luna Park will leave soon from my village. Thus, I decided to draw a sketch in order to build my own carousel.

Do you want to build a carousel?

### Build

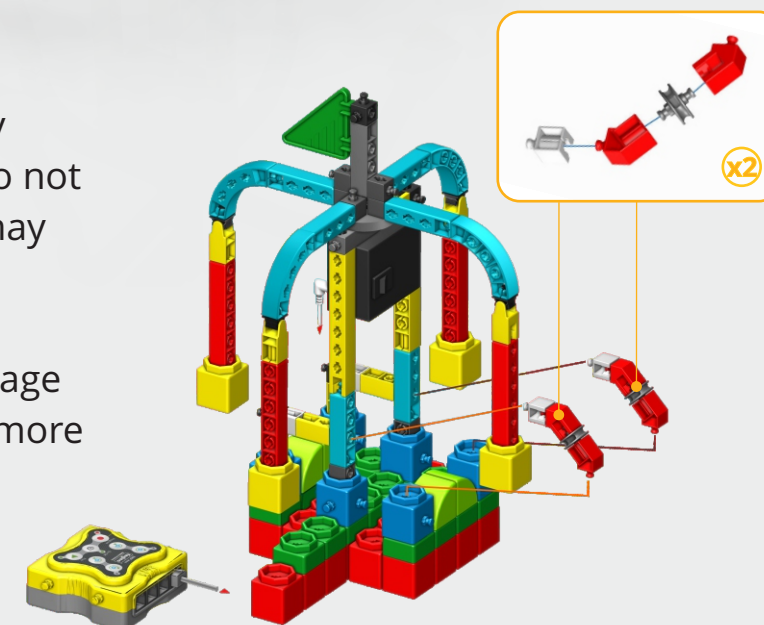
Build the "Carousel" model with your team.



### Challenge 1

Test the stability of your model by pushing it from different sides. Do not push it too hard though, as this may break the construction.

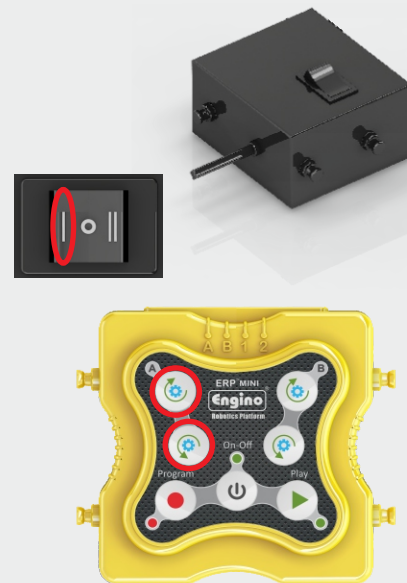
Can you make it stronger? The image on the right can help you build a more stable construction.





## Challenge 2

The carousel you have just built, must operate! Set the motor switch on position **I** and power up the controller with the On-Off button. Press the motor A buttons on the controller. Write your own observations in the following lines:

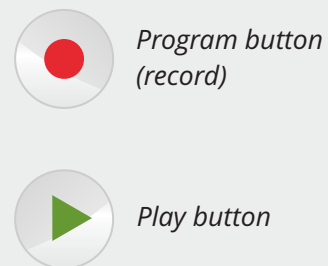


## Challenge 3

Create a program manually by pressing the red **recording** button and then push the correct motor buttons so that:

- the carousel rotates clockwise,
- the carousel rotates anticlockwise.

Press the program button again to save your commands and then the **Play** button to run the program.



## Conclusion

Some of the robotic components are shown below. Explain the use of each one by matching the name with the description.



Mini controller •

• connects the robotic platform with the other peripherals.



Motor •

• is the device that set the robot into motion.



Wire •

• is the brain of the robot.



## Theory

### Amusement Park

#### Merry-go-round

Carousel is a fun ride consisting of a rotating circular platform with seats. Usually the seats come in the form of horses or other animals (e.g. zebras) or mythical creatures (e.g. unicorns). Early carousels had no platforms; the seats would hang from chains.



#### Ferris wheel

A Ferris wheel is a structure that consists of a large rotating wheel able to carry passengers inside compartments (or capsules) attached to its rim. One famous example of a giant Ferris wheel is the London Eye. As denoted by its name, the wheel is located in London (UK).



#### Booster ride

Another spectacular ride found in amusement parks is the Booster ride. The game consists of a gondola, arm and an axle. One end of the arm is fitted with a passenger-carrying gondola, while the other is attached to the axle. Gondolas swing back and forth and in some rides they even rotate, sending people through a complete inversion!





## Manual programming

Modern robotic technology allows us to create a factory robotic program through manual programming by using a **teach pendant**. The user controls the robot remotely and the sequence of commands (the program) is generated and saved automatically.



## Mini controller



The Mini controller allows manual control and recording by pushing the controller's membrane buttons. To begin manual recording press the "Program" button once and press the buttons of the motors at any desired order. Press again the "Program" button to save the program in the controller's memory.



Press the "Play" button to start the program; if you hold it for 3 seconds the program will be repeated in a loop. Note that the device can save only one program in its memory. Moreover, each step is recorded for the period of time that the button is being pressed.

## Did you know?

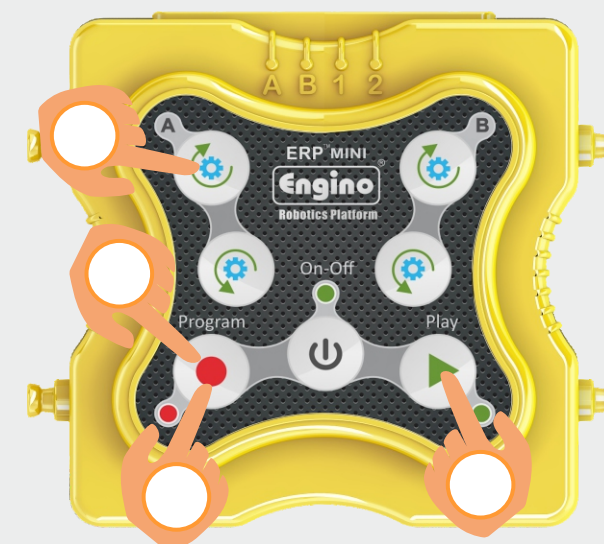
The construction of the London Eye started in the late 1998. In the process, over 1700 tonnes of steel were used for the structure and more than 3000 tonnes of concrete were used for the foundations.



The London Eye was a huge European project! Its major components came from six countries: the steel was supplied from the UK and fabricated in the Netherlands. The cables and the glass of the capsules came from Italy, while the bearings came from Germany. The 32 passenger capsules were made in France and the 25 metres long spindle (the rotating shaft of the wheel) was built in the Czech Republic. The electrical parts were made in the UK.

## Extra Challenge

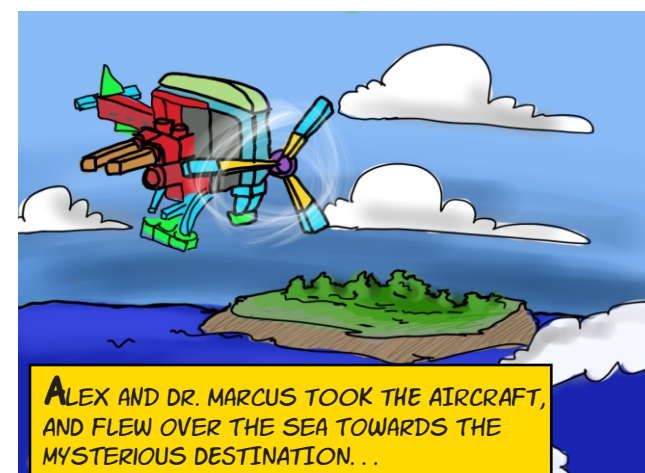
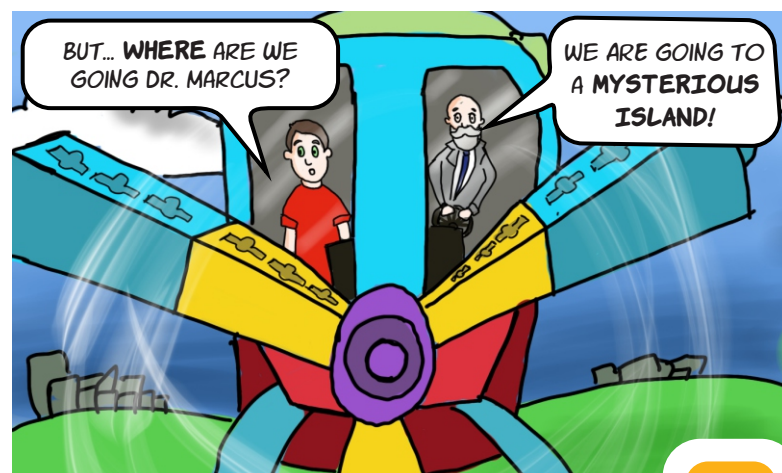
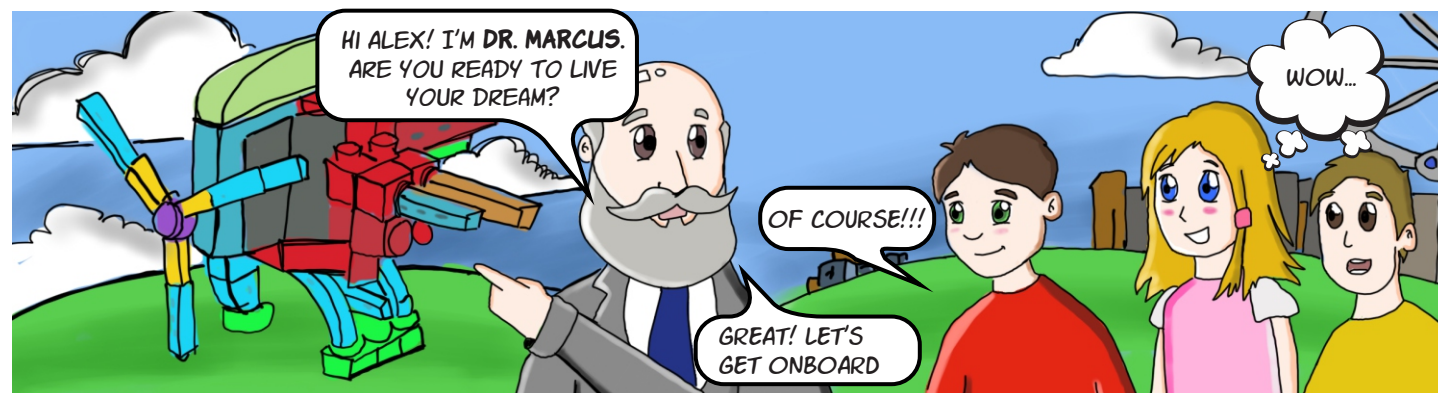
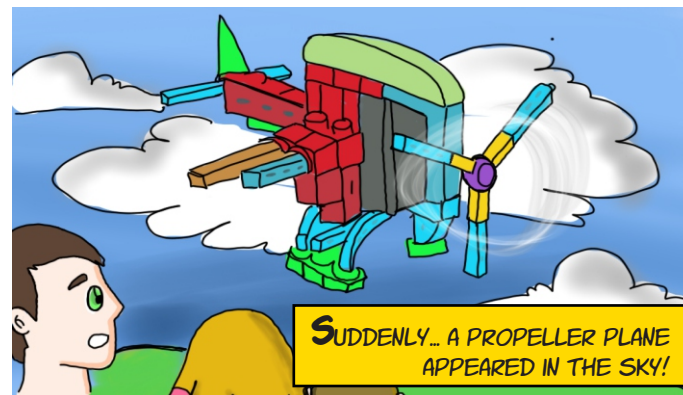
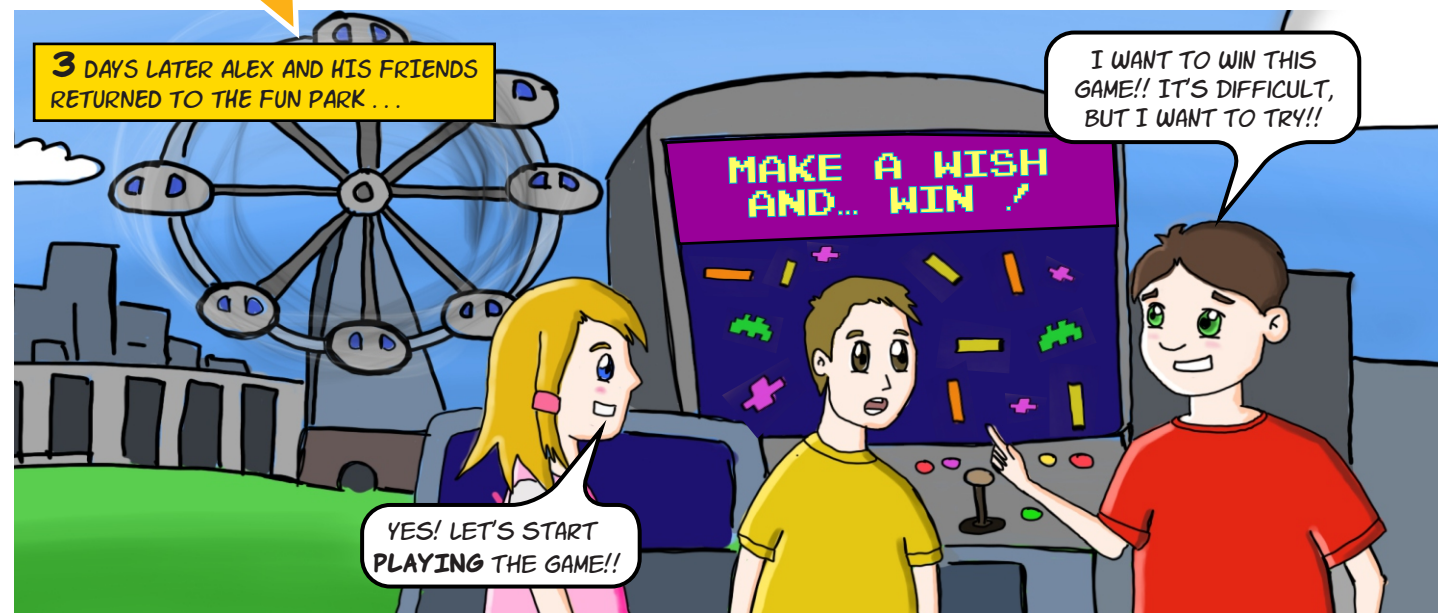
Create a manual program so that *the motor rotates clockwise for 5 seconds* (count to 5). Write the numbers (1, 2, 3, 4) in the circles below to show the sequence you used to press the buttons.



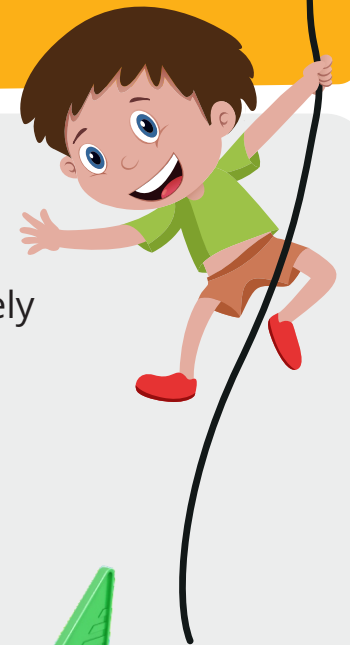




## Episode 3: A WISH COMES TRUE



## Activities



In the fun park I discovered an interesting puzzle game. While I was playing this amazing game, I noticed a flying object in the sky. It was a plane with propellers. I immediately jumped into it wishing to experience an adventure.

Do you want to travel together towards the mysterious island? Let's try to build a propeller plane!

### Build

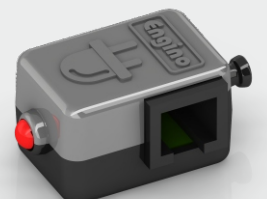
Build the “**Propeller plane**” model with your team.



### Challenge 1

Dr. Marcus and Alex had a small problem with their flight. Due to the darkness of the night, they could barely see how to get to the mysterious island. They had to add a light source to overcome this issue.

Choose an appropriate place on the “Propeller plane” model, attach the **LED** and connect it to port B of the controller. Press the port's button on the controller to light the sky and help Dr. Marcus and Alex travel towards the mysterious island!!





## Challenge 2

Create the following program by pushing the buttons on the controller, so that:

- *propellers rotate clockwise for 2 seconds,*
- *propellers rotate anticlockwise for 3 seconds and LED light turns ON at the same time.*





## Challenge 3

Open the EnginoRobotBT app from a smart device. Scan to find the Mini controller, connect your controller and choose the ERP Mode. Use the interface of the app to record a program manually. Press the red button and the appropriate sequence of buttons, so that:

- *propellers rotate clockwise,*
- *the LED light turns ON,*
- *propellers rotate anticlockwise.*



Press the "Program" button  again to save your commands and then press the "Play" button  to run the program.

## Conclusion

Circle the correct words so that the sentences below are true:

1. To create a manual program from the controller, the **Play / Program** button must be pressed first.
2. When recording is done, the controller will execute the recorded commands by pressing the **Play / Program** button.



## Theory

### Types of Transportation

People use various methods to move themselves and their goods from one place to another. We use the word "**transportation**" to refer to all those methods of travel through **land**, **air** or **water**.



### Air Transportation

Air transportation is used to carry goods and people to distant areas in relatively short time. For example, airplanes are commonly used by people to travel in long distances. Helicopters are commonly used in emergency situations as they can reach fast any remote area.



### Sea Transportation

Sea transportation is the process of moving over water (sea, ocean, river, lake, canal). Cargo ships can transfer heavy and huge goods like cars, electrical appliances, etc. Passengers can travel by boats and yachts between areas where land transportation is not accessible, such as islands or river banks.





## Land Transportation

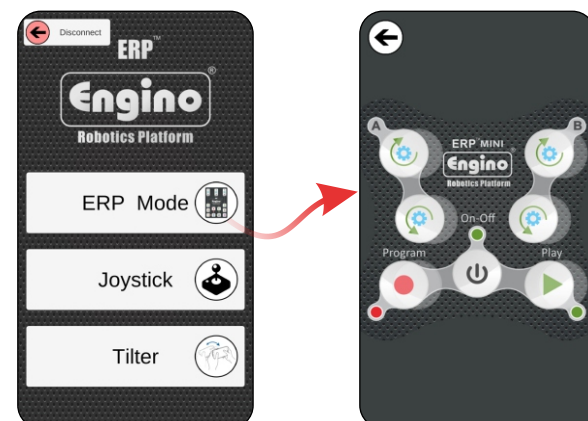
**Road Transportation:** A very common way of transportation is by using road routes. This type involves the use of motor vehicles such as cars, motorbikes, buses, bicycles and trucks. They mostly travel on paved streets but some specialized vehicles are designed to travel off-road.



**Railway Transportation:** Railed vehicles and wagons are moving on a fixed path either above the land or underground. Trains travel very fast, more than 400 km/h and have no traffic. They stop only at specific locations, called stations, where people can leave or board the train.

## EnginoRobotBT app

The EnginoRobotBT™ app is available on Google Play or Apple Store. It is essentially simulating the interface of the actual controller. Users can control the model, record and play a program just as they could do by pushing the physical buttons on the MINI controller. All these can be achieved remotely and digitally!



## Did you know?

Propeller planes are pretty much used in air-racing and aerobatics. This sport is highly demanding since the planes have to perform sudden turns, spins, loops and make steep dives and climbs.



Races with planes are very exciting and entertaining. Pilots are racing against each other over a racetrack in the sky! They have to be extremely skilful to manage the sudden changes in direction while flying in high speeds. The forces which pilots may feel when attempting a sudden manoeuvre can be as much as 10 times their weight! These pilots need to be strong and fit to maintain such heart pounding races.

## Extra Challenge

**Modify the “Propeller plane” model and try to make bigger blades using Engino parts.**

**Use the EnginoRobotBT app to create a program so that:**

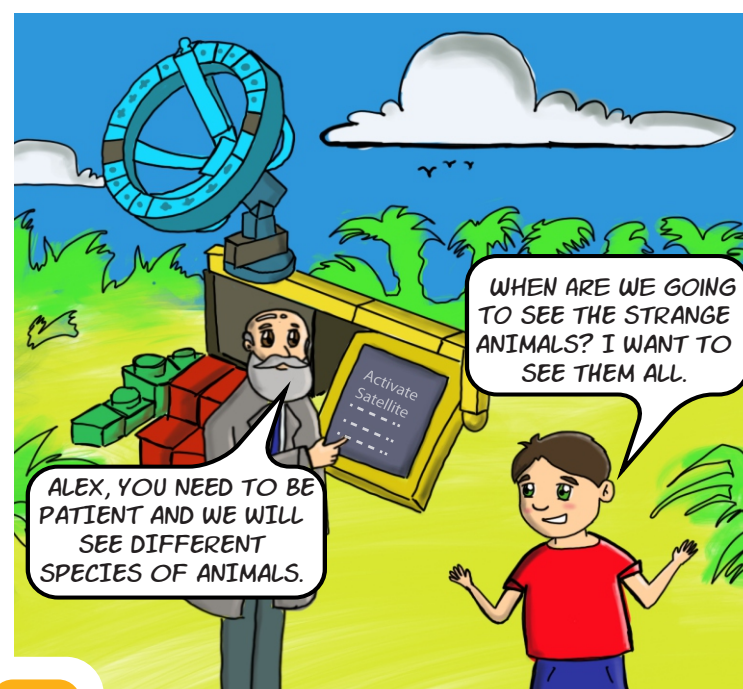
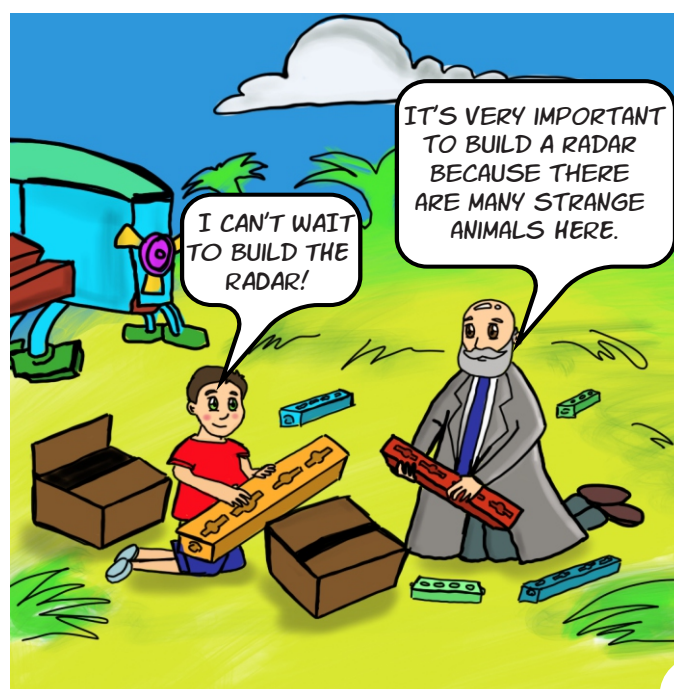
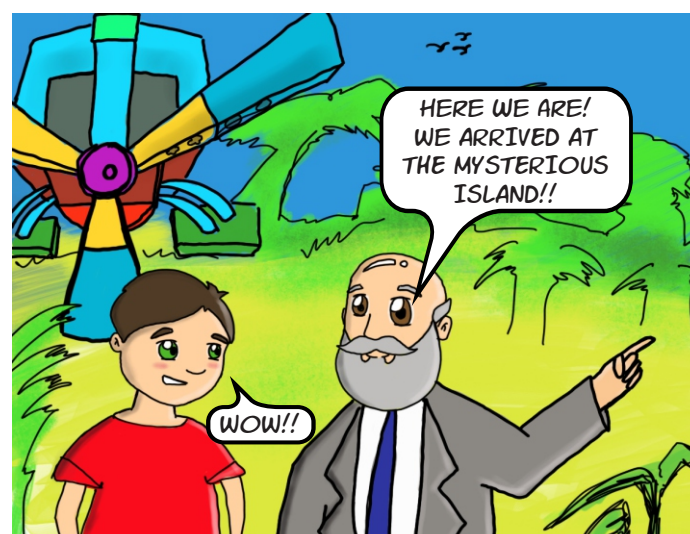
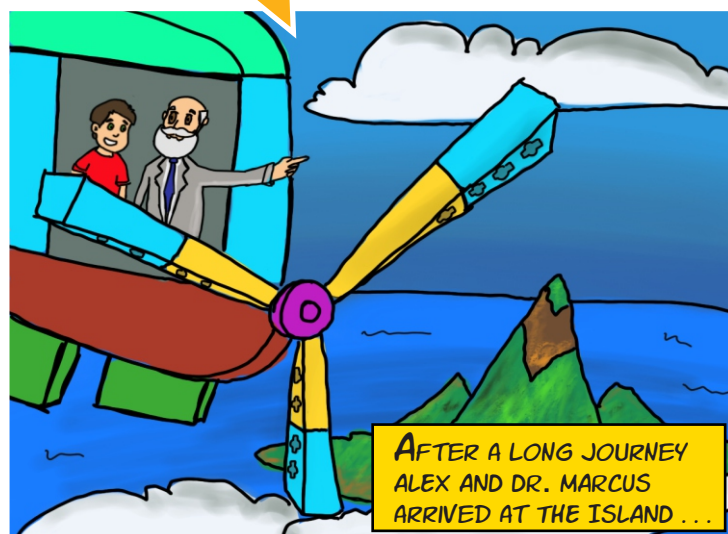
- *propellers rotate clockwise for 2 seconds,*
- *the LED light turns ON for 3 seconds,*
- *propellers rotate anticlockwise and LED turns ON for 5 seconds at the same time.*







## Episode 4: OPERATING A RADAR



## Activities



As soon as we landed on the island we had to build a radar. Dr. Marcus explained to me how important it was to build this radar. I didn't know how to detect objects from long distance. We could find dinosaurs or other animals around us and protect ourselves from any danger.

Do you want to help Alex and Dr. Marcus build this machine?

### Build

Build the “**Radar**” model with your team.



### Challenge 1





Using the EnginoRobotBT and press the “**Program**” button through the ERP mode to record the following program:

- radar turns anticlockwise for 2 seconds,
- then, the LED light turns ON for 1 second,
- and finally, radar moves clockwise for 3 seconds.

Press the “**Program**” button again to save your commands and then press the “**Play**” button to run the program.



## Challenge 2

Connect the controller with the PC through USB or with the tablet through bluetooth. Click on the **"USB"**  or the **"Bluetooth"** icon  accordingly, within the KEIRO™ software and once connected click on the **"Receive program"** icon  that will appear. Choose the connected elements for each port on the pop-up window. Make an overview of the appeared blocks and check their properties. Can you make the appropriate changes so that motor speed becomes 80 when radar turns anticlockwise? **Send** the program to the Mini controller by clicking on the **"Send program"** icon  and check it.

Receive Program

Please select the elements connected to each port:

Any changes on the flow will be lost!

Port A:

Port B:

Close

OK





## Challenge 3

You can make a block run at the same time with the previous block by selecting **"WITH"** instead of "AFTER" through the last property of an action block. Edit the program so that it performs the following commands:

- *radar turns anticlockwise with speed set at 80 for 2 seconds,*
- *then, radar turns clockwise with speed of 40 with the LED light turned ON at the same time for 3 seconds.*

## Conclusion

**Motor and LED light are blocks that appears in the KEIRO™ software. Which properties can be found in each of the two blocks? Place a ✓ on the table below.**

|   | Port<br> | State<br> | Direction<br> | Speed<br> | Delay<br> | Duration<br> | Previous<br> |
|---|---|--|--|--|--|---|---|
| Motor  |   |  |  |  |  |   |   |
| Led    |   |  |  |  |  |   |   |



## Theory

### Radar

The word "radar" is an acronym for Radio Detection and Ranging. Radar is a system that uses the radio waves to detect objects from far away. Moreover, a radar can detect how fast an object is moving. Radars can even sense objects at night through clouds and fog.



### Uses of radar

There are many uses of radar. For example, air traffic controllers use radar to keep track of planes and direct their movements. Planes and ships also use radar to shedule their routes. The weather forecasters use the radar to predict the weather.



### How a radar works

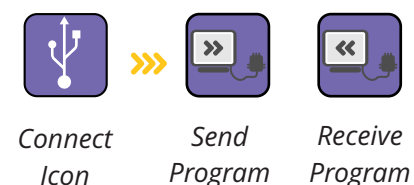
A radar uses an electromagnetic system used to detect the location and distance of an object from the point where the radar is placed. It works by radiating energy into space and monitoring the echo or reflected signal from the objects.





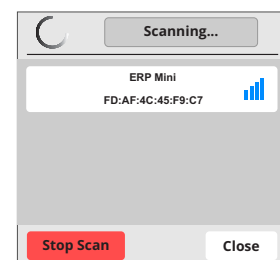
## Connect with a PC

You can connect the controller to the PC with the included mini USB cable and then by clicking on the appropriate menu icon. Once the connection is successful, two new buttons will appear on the menu. You can "Send" a program from a PC to the controller, or vice versa, by clicking on the appropriate buttons.



## Connect with a Smart Device

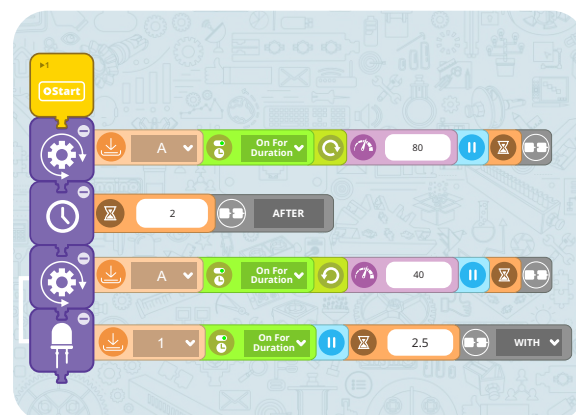
Using **KEIRO™** software through **smart devices** (Android and iOS platform), the bluetooth icon appears on the menu bar. To achieve a connection with the controller, enable bluetooth from your device and turn on the controller. By clicking on the bluetooth icon the software scans for available devices.



Scan for bluetooth devices and connect to your ERP Mini

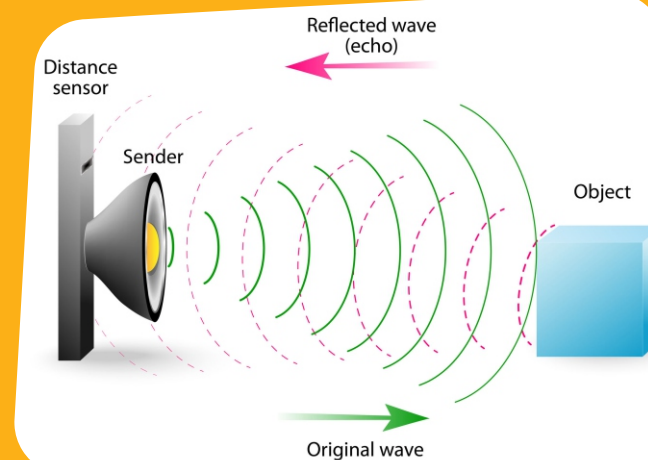
## After/With functions

A major innovation of Engino® in educational robotics is the function of parallel programming. Action blocks in KEIRO™ software contain an ingenious property which allows the user to choose whether a command will be executed **after** or **with the previous** one. This feature reduces the complexity of programming and allow sophisticated tasks become more feasible.



## Did you know?

There is a different kind of radar and it's called "sonar". The word "sonar" comes from the first letters of "sound navigation ranging". Sonar is a system which detect objects under the sea by echoes, the same way that sea animals navigate using their natural sonar systems (such as whales).



There are some sonars which emit sounds you can hear, but some other sonar signals are pitched so high that the human ear cannot hear them. These signals are called ultrasonic waves. Sonar has many uses. For example, submarines use sonar to detect other vessels. Oceanographers use sonar to map the contours of the ocean floor etc.

## Extra Challenge

Open the KEIRO™ software and make the following program:

- radar turns clockwise for 2 seconds,
- the LED light turns ON,
- radar turns anticlockwise with the LED light turned ON for 2 seconds.

Adjust the duration so that the radar turns anticlockwise for 4 seconds.

