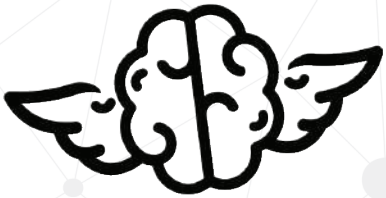
Spreading the Joy of Science

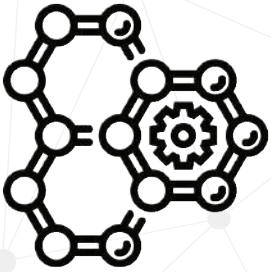
AUTONOMOUS VEHICLE KIT USER MANUAL

CONTENTS

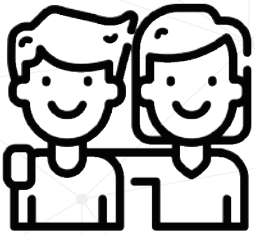
WHAT IS TWIN?



FREE MINDS



UNIQUE EXPERIMENTS



SELF-CONFIDENT INDIVIDUALS

Twin is an entertaining and educatory robotic and coding kit that develops imagination.

It nurtures our sense of curiosity that exists in our nature,
shows how easy and understandable science actually is, encourages us to do more.

" Science is knowledge and knowledge is to know yourself." Yunus Emre

Twin consists of electronic modules that can be attached with magnets. It requires no risky process of welding. We aim to make the science and technology popular and develop the sense of know-how for the public.

With Twin kits, children and teenagers are able to develop the latest technology of robotics and autonomous cars by simple attachments. With the projects we provide, they will be able to develop their own unique projects to provide solutions to world problems. At advanced stages, we shall provide the kids with the scientific knowledge of the projects they have performed to complement the "learning by doing" concept.

The kids that play with Twin;

- **Have creativity,**
- **Have dexterity,**
- **Have their best dreams realized!**

Kids can also enjoy playing with their LEGO® bricks to the fullest because Twin is compatible with LEGO® bricks!

TWIN AS A SOCIAL PROGRAM: Latest Technology to the Remotest Rural Areas

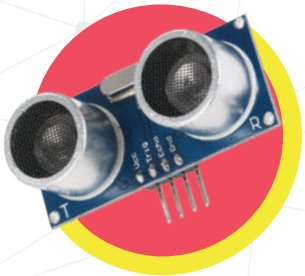
We believe that the human knowledge and love grow by sharing. Twin not only presents the most advanced technology to the kids, but it also delivers it to those in the most disadvantaged echelons of the society.

Twin implies being two-winged by heart and mind. We dream of spreading the Twin concept of creating and sharing to the world. Twin as a social program works within the scope of a global Science Movement campaign of YGA (Young Guru Academy) worldwide, in partnership with universities, education and training centers as well.

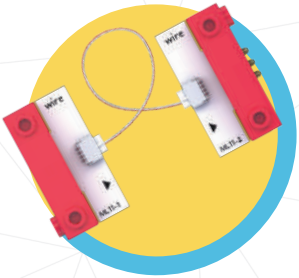
By purchasing this kit, you've contributed to the Science Movement Campaign extending to the remotest villages. Twin is a start-up founded by YGA graduates. It has been developed with the guidance of Turkey's first science Nobel laureate Prof. Aziz Sancar, Harvard & MIT Prof. Mehmet Toner and Prof. Doğan Cüceloğlu.

What's Inside the Autonomous Vehicle Kit?

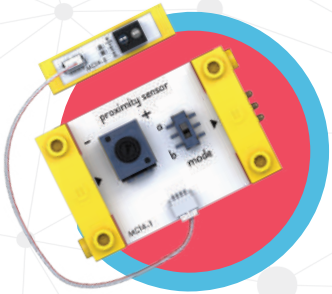
Twin Modules



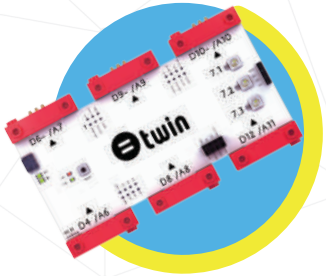
Ultrasonic Sensor



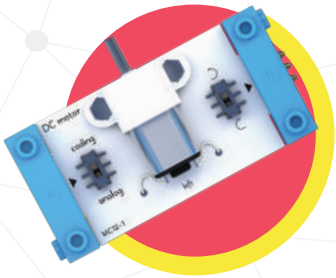
Wire x2



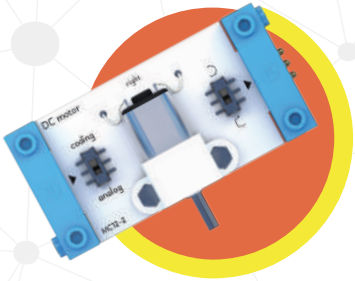
Proximity Sensor x2



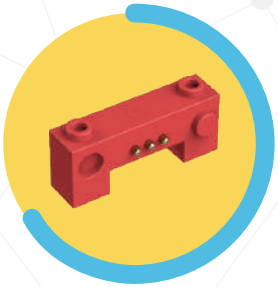
Coding Module



DC Motor Left



DC Motor Right



Signal Conductor x2

Additional Materials

Ford F-Max Truck Cabin

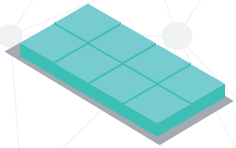
Male-Male Jumper Cable

Tires x4

Ball Caster

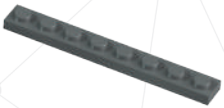
Male-Female Jumper Cable

Glass, Headlights and Logo Stickers

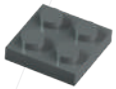


Sticky Dough

2x8
Thin Block
2 pcs



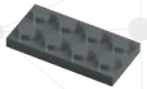
1x8
Thin Block
2 pcs



1x8
Thin Block
2 pcs

1x2
Thin Two-Sided
Block
2 pcs

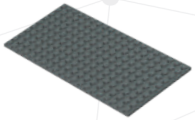
1x2
Thin Block
4 pcs



2x4
Thin Block
8 pcs

2x4 Square
Two-Sided Block
4 pcs

1x16
Technical
Block
4 pcs



10x20
Thin Block
1 pc

2x2
Round Block
2 pcs

2x2
Two-sided
connection
4 pcs

2x10
Thin Block
1 pc

2x6
Thick Block
4 pcs

1x9
Perforated
Technical Block
1 pcs

2x4
Perforated
Technical Block
1 pc

3x3
Perforated
Technical Block
1 pc

1x4
Perforated
Technical Block
2 pcs

2x4
Two-sided
connection
4 pcs

12 cm Shaft
2 pcs

Gears

8 Gear
4 pcs

40 Gear
4 pcs

24 Gear
2 pcs

24 Crown Gear
2 pcs

Small Tire Gear
2 pcs

16 Gear
2 pcs

Connection Parts

Cross
Rotation
Part
2 pcs

Small Pulley
10 pcs

Roller Shaft
4 pcs

One Way
Extension
Shaft
4 pcs

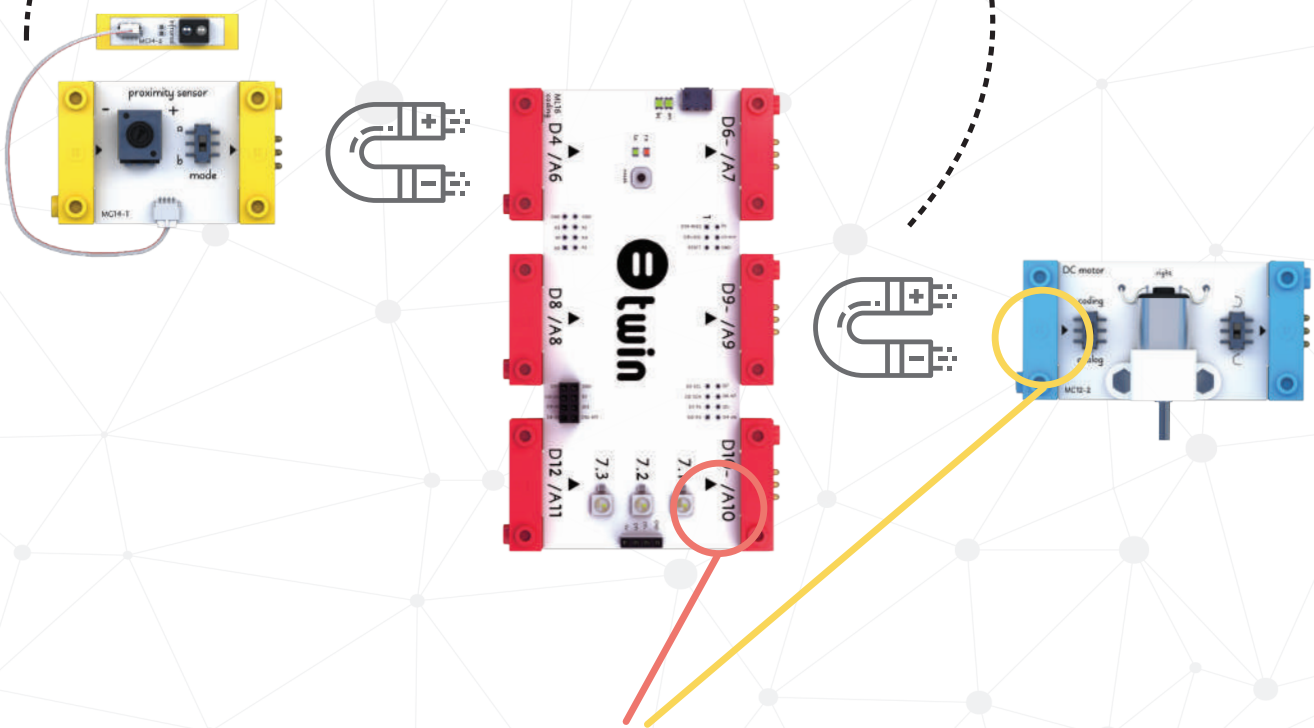
Motor
Connection
8 pcs

MEET THE TWIN MODULES

Bring the modules closer to connect them.

Modules are connected to each other by means of the magnets in them.

When you try to make a reverse connection, they push each other.
Try It!



The energy flows in the direction of the arrow.
Make sure that the arrows show the same direction when you connect them.

Meet the Twin Colors

Twin modules are defined in **4 different colors** according to their functions.

power

Power modules come first and provide power for the circuit to work.

input

Input modules send signals to the module that comes afterwards.

logic/transmission

These modules allow you to expand and change the direction of your circuits, as well as controlling modules.

output

Output modules produce output such as sound, motion, and light.

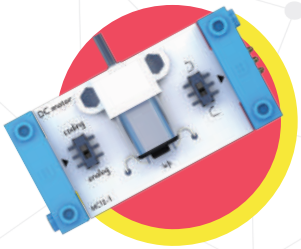
Bring Your Toys to Life

Twin modules have been designed to be compatible with LEGO® bricks.
You can prepare your circuit and combine it with LEGO® bricks as you wish.

DC MOTOR

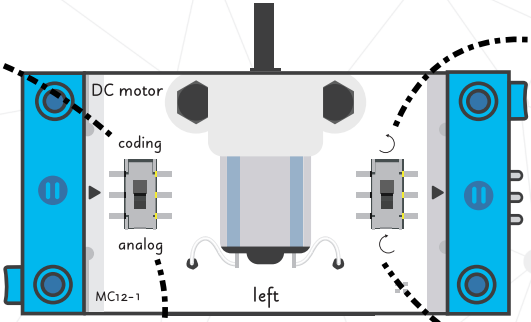
Motor converts electric energy into mechanical energy. It is the mechanical energy that provides rotational movement.

Directions of DC Motor Right and DC Motor Left modules are different.



Switch to **"coding"** mode when using with coding module.

Switch to **"analog"** mode when using with other modules.

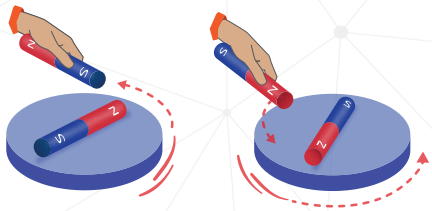


Counterclockwise rotation.

Clockwise rotation.

How Does It Work?

Inside the electric motor, there are magnets and winded copper wire called coil. In the magnets, opposite poles attract each other while the same poles repel which means they push each other. Copper, which is normally an element that does not exhibit magnet properties, shows magnetic properties when electric current flows through it. In short, it becomes an **"electromagnet"**. The copper coil and the magnets inside the motor attract and repel each other as shown in the figure. This way, our motor rotates as long as there is electricity.



For Curious Ones

The interaction of substances that exhibit magnet properties in repelling and attracting each other is called magnetism. Have you ever thought where the word magnetism came from?

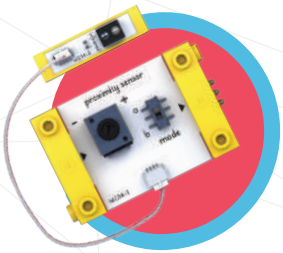
In fact, there are many stories! One of them is the story of a shepherd named Magnes!

One day when he was going up to the mountain, he found out that the nails in his shoes stick to the ground and the mountain has a magnetic property. In another story, it is believed that Magnes lived in a city called Magnesia. It is told that when the magnetic feature of Spil Mountain was discovered, this substance was named with the name of the city.

Do you know the current name of the city Magnesia?

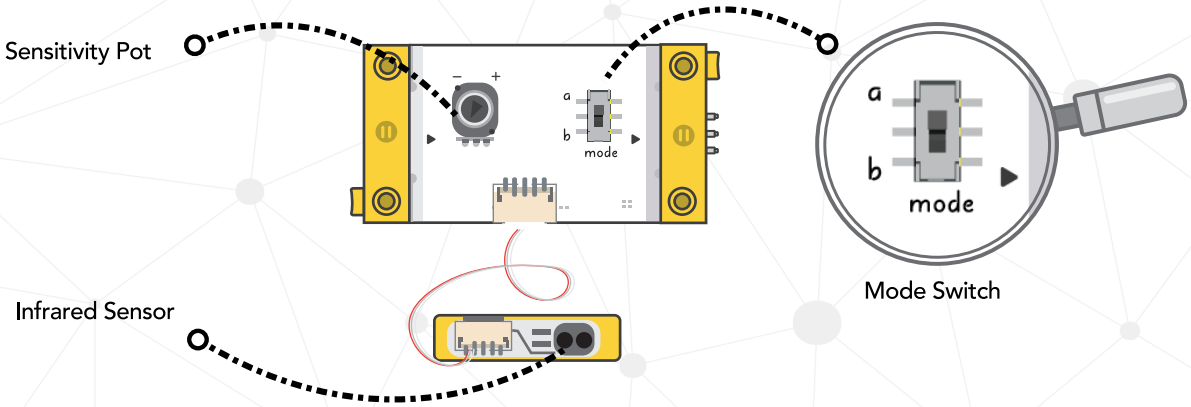
Answer: Manisa

PROXIMITY SENSOR

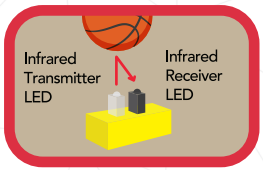


You can adjust its sensitivity with the pot on it. It detects objects that are farther when you increase the sensitivity and that are closer when you reduce it.

In "a" mode, blocks signal when it sees an obstacle.
In "b" mode, transmits signal when it sees an obstacle.



How Does It Work?



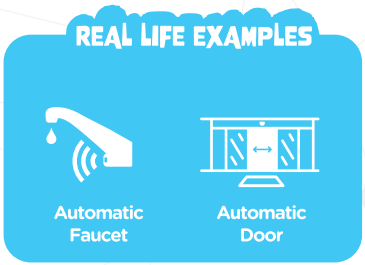
The infrared transmitter LED on the sensor sends infrared light, and the receiver collects the infrared light that reflects from the object. According to the angle of the light received by the receiver, the distance between sensor and object is calculated.

For Curious Ones

Can we see the infrared light?

Even if you cannot see the infrared light with naked eyes, you can see it with the help of camera.

Different creatures can see lights of different colours. For example, some bird species can see ultraviolet lights that people cannot see.

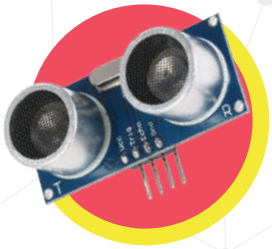


ULTRASONIC SENSOR

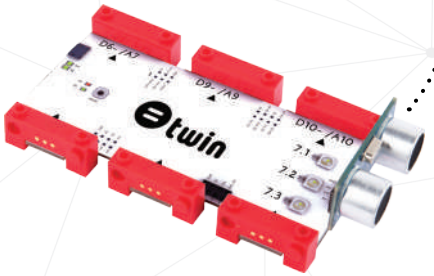
Ultrasonic sensor measures the distance of obstacles in front of it. It can detect distances in 3-400 cm range. It works by placing it in the slots on the coding module.

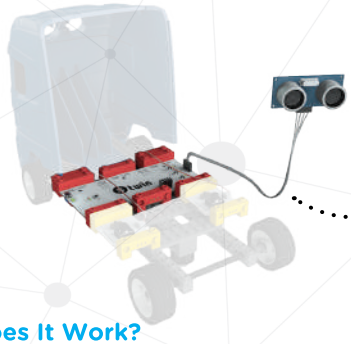
T = Transmitter
Sends sound waves.

R = Receiver
Collects returning sound waves.



The ultrasonic sensor is connected to the Twin coding module as shown in the figure



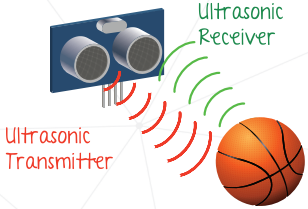


Connection distance can be extended by using jumper cables.

WARNING:

Wrong connections can damage the circuit.
Connect it to coding module as shown in the figure.

How Does It Work?

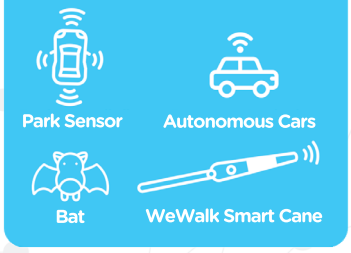


Ultrasonic means beyond sound. Humans can hear sounds between frequencies 20-20.000 Hertz. Ultrasonic sends over 20.000 Hertz waves. While these sound waves striking to the obstacle are returning, the receivers on the sensor detect how far the obstacle is.

For Curious Ones

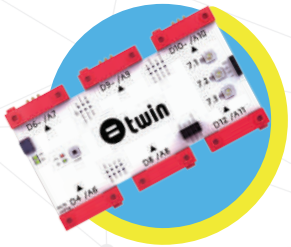
Ultrasonic sensor is produced inspired by bats in the nature. Developing a product or a solution by getting inspired by the nature is called biomimetic. Bats find the obstacles around them by detecting the reflection of ultrasonic waves they sent.

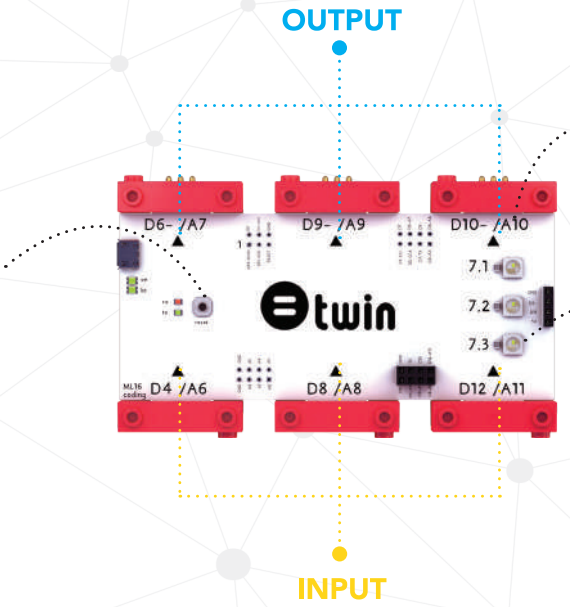
REAL LIFE EXAMPLES



CODING

Coding module is an Arduino-based development board.





You can restart the coding module by pressing the "RESET" button on it.

The letters D and A are abbreviations of Digital and Analog signals. Digital Signal is to send either 0 Volt or 5 Volt to the circuit. With Analog Signal, it is possible to send any value in between 0V and 5V to the circuit.

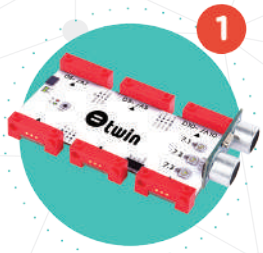
Do you know that 17 million different colors of light come out of here?

- There are 3 input, 3 output connections on coding module.
- Use the output connections to have outputs such as sound, light, and motion with blue modules.
- Yellow sensor modules such as light, sound, proximity are added to the input connections.
- You will see numbers next to the input and output connections. These numbers indicate the location of the modules you connected.

REAL LIFE EXAMPLES

Brain Computer

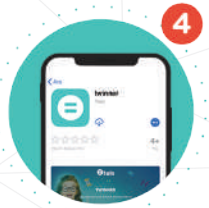
TRY IT!



Remove the coding module from the box

Connect it to the powerbank.
Use the charger or computer

Make sure the red light is lit.



Download **Twinner Mobile App** from **Google Play** or **App Store.**

Open the mobile application and sign up.

Click on **coding.**

Click on examples, select **City Lights.**

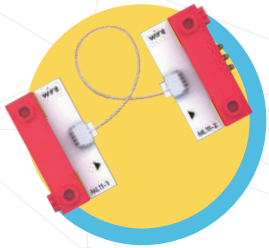
Click on **Play button** on upper right.

Turn on Bluetooth and match it with your module.

Are you connected?
Click on **Play Again** button.
Are the lights on?

You can proceed with the guide and other examples in the application.

WIRE



Wire allows you to connect the modules by keeping a distance between them.

How Does It Work?

Inside the wire, there is a copper cable which is a conductor.
It transmits electrical signals to long distances.

For Curious Ones

How is the electricity conducted?

Electrical conduction happens thanks to the electrons that can freely move. Some materials conduct electricity better than others like silver, copper, and gold. Although silver is the best conductor, generally copper is used in cables since it is cheaper than silver.

REAL LIFE EXAMPLES

High tension line

Cable

MANAGE THE EXPERIMENTS FROM TWINNER

+

The adventure continues in Twinner!

Everything you need to code and manage
the autonomous vehicles you made is in Twinner mobile application.

Download now, start exploring!

You can download Twinner application to your device from **Google Play** or **App Store**.

Download on the App Store

GET IT ON Google Play


IT'S PROJECT
TIME


FORDTRUCKS

The Twin Autonomous Vehicle Kit was developed with the support of Turkish engineers engaged in research and development at Ford Otosan.

SMART DOOR

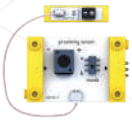
20 MIN EXPERIMENT DURATION

BEGINNER LEVEL

+

Required modules

Coding Module



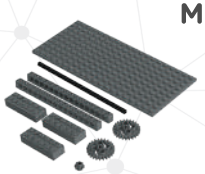
Proximity Sensor

Left DC Motor

Signal Conductor

Additional Materials

Powerbank



Building Blocks

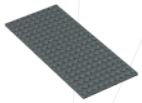
USB Cable

Twinner App

Building Blocks

2x6 Thick Block 3 pcs

1x16 Perforated Technical Block 2 pcs



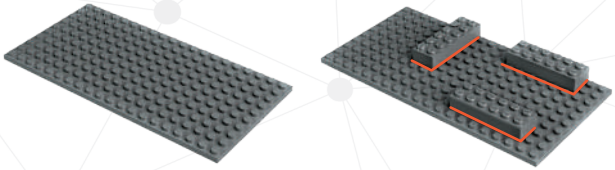
10x20 Thin Block 1 pc

8 Gear 1 pc

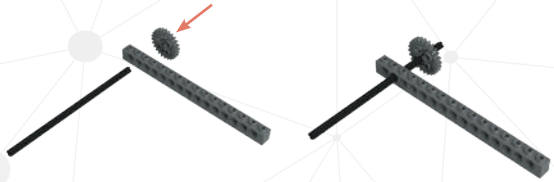
24 crown gear 2 pcs

12 cm Shaft 1 pc

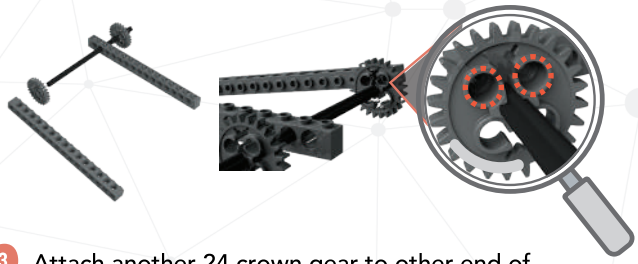
Project Steps



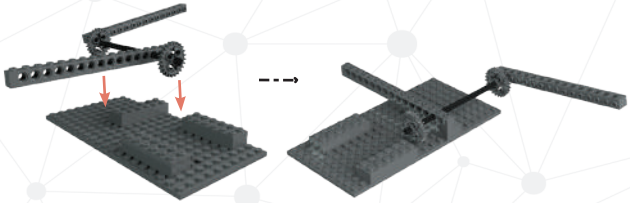
1. Add 3 pcs 2x6 thick blocks on top of thin floor block as shown in figure.



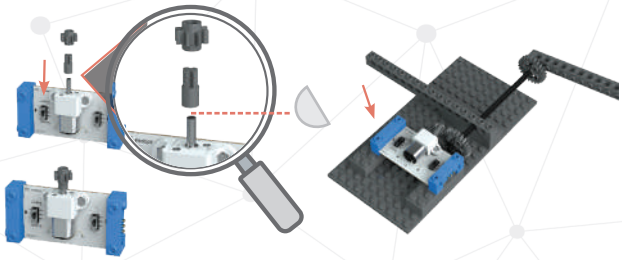
2. Pass the 12cm shaft through second hole of 1x16 technical block and attach the 24 crown gear to its end.



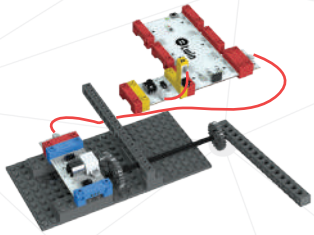
3. Attach another 24 crown gear to other end of the shaft. Attach the pawls of 1x16 technical block to the gaps of the gear and fix the block.



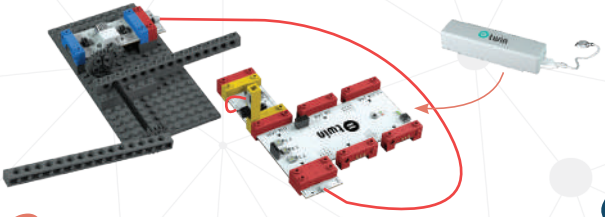
4. Mount 1x16 technical block on top of 2x6 thick block as shown in the figure.



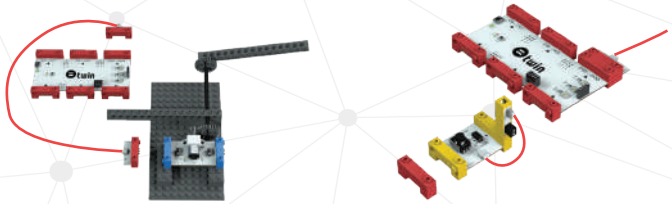
5 Attach motor connection part and 8 gear to DC Motor as shown in the figure.
Make sure you are using the Left DC Motor.



7 Connect the other end of the wire to DC Motor and place the modules on 2x6 thick block.
Make sure the DC Motor is in "coding" mode.



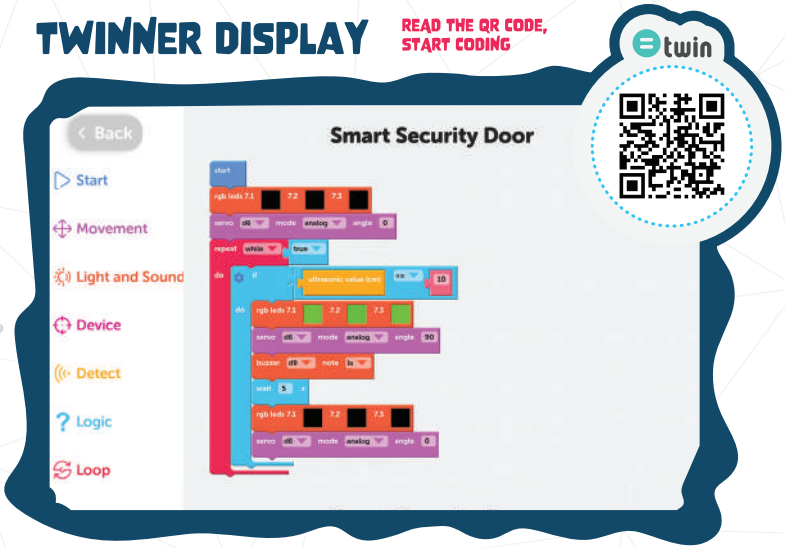
8 After completion of steps, make sure the project looks like the figure.



6 Add Proximity Sensor to D12/A11 input of Coding Module. Attach Signal Conductor in front of Proximity Sensor. Connect the wire to D10/A10 output of Coding Module.
Make sure the Proximity Sensor is in mode "b".

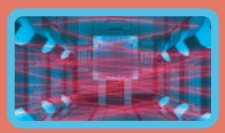
TWINNER DISPLAY

READ THE QR CODE, START CODING

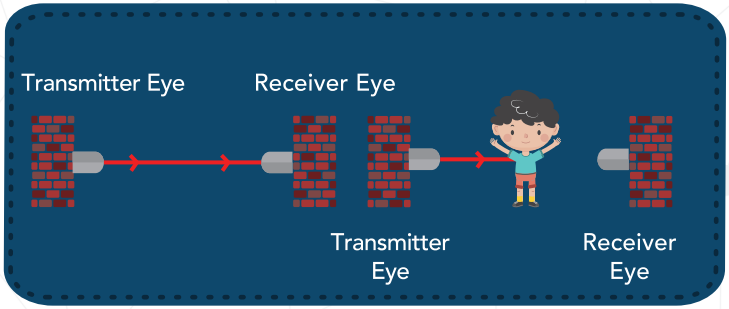


FOR CURIOUS ONES

Have you ever wondered how laser alarm systems in movies work?



Receiver and transmitter are located side by side in Proximity Sensor module. It detects the obstacle in front of it by sensing the light reflecting from the obstacle. In some alarm systems, receiver and transmitter are located at the opposite ends. The light transmitted from transmitter must reach to the receiver. If an obstacle enters in between, the light cannot reach the receiver and alarm goes off.



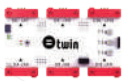
SMART MANUFACTURING LINE

30 MIN EXPERIMENT DURATION

MEDIUM LEVEL

+

Required Modules



Coding Module

Proximity Sensor x2

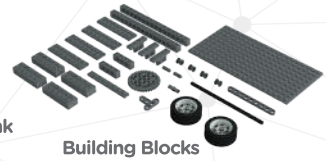
DC Motor x2

Signal Conductor x2

Wire x2

Powerbank

Additional Materials



Building Blocks

USB Cable

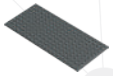
Twinner App

Building Blocks

1x16 Perforated Technical Block 3 pcs

2x8 Thin Block 4 pcs

Small Pulley 4 pcs



10x20 Thin Block 1 pc

1x8 Thin Block 1 pc

40 gear 1 pc

Roller Shaft 1 pc

3x3 T Perforated Technical Block 1 pc

1x4 Perforated Technical Block 2 pcs

2x4 Two-Sided Connection 3 pcs

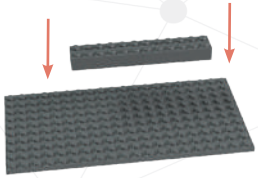
2x6 Thick Block 4 pcs

12 cm Shaft 1 pc

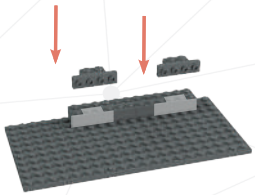
Motor Connection Part 2 pcs

2 x 4 Thin Block 2 pcs

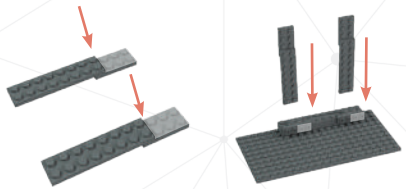
Project Steps



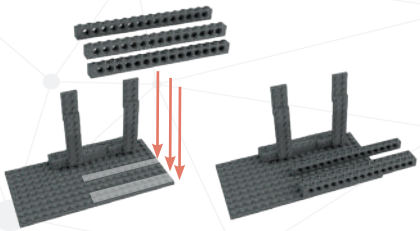
1 Mount 2 pcs 2x6 thick block on top of thin floor block.



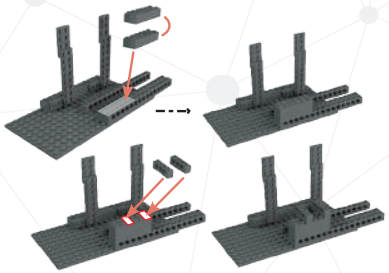
2 Mount two-sided connection parts on top of thick blocks.



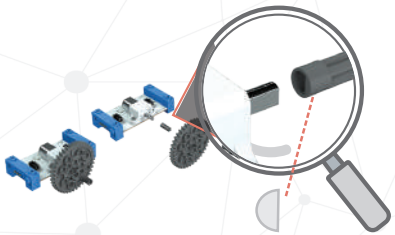
3 Combine 2 pcs 2x8 blocks with 2x4 blocks as shown in the figure.



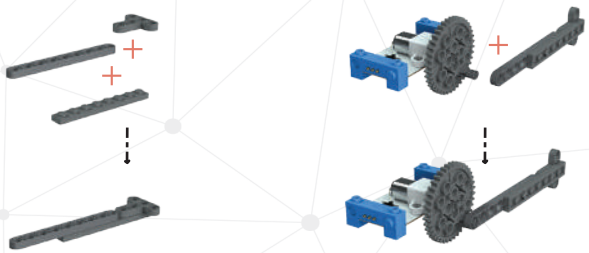
4 Mount 3 pcs 1x16 technical blocks on top of thin floor block.



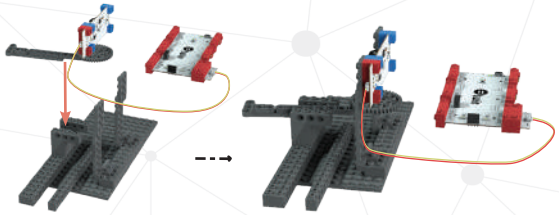
5 After attaching 2 pcs 2x6 thick block as shown in the figure, attach 2 pcs 1x4 technical blocks on top of them.



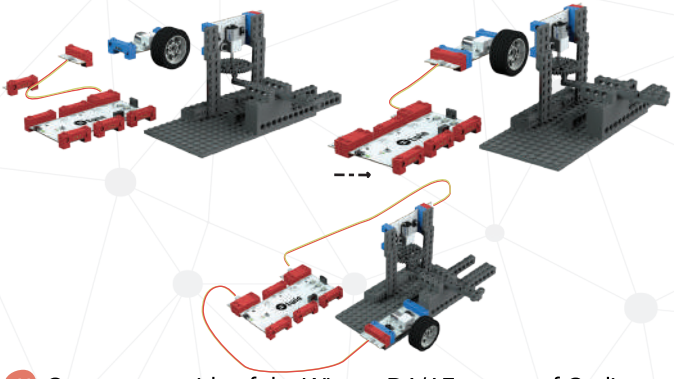
6 Combine DC Motor, motor connection part, 40 gear and roller shaft as shown in the figure. **Make sure DC Motor shaft and connection part are combined as shown in the figure.**



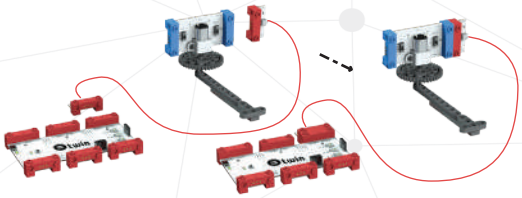
7 Attach 1x9 perforated technical block and 3x3 T perforated block on top of 1x8 thin block as shown in the figure. Mount the roller shaft to the first hole of 1x9 technical block.



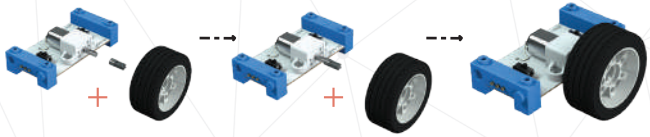
9 Connect DC Motor and Wire modules to the back side of 2x4 thin blocks as shown in the figure.



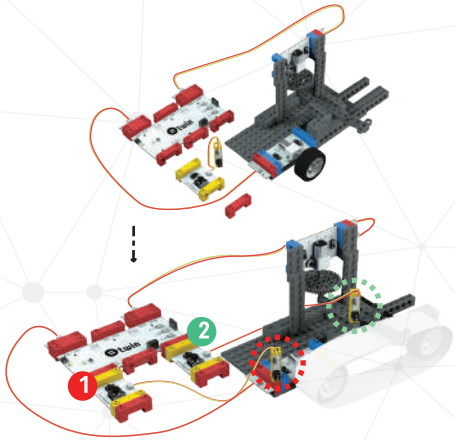
11 Connect one side of the Wire to D6/A7 output of Coding Module and other side to DC Motor. Add DC Motor to thin floor block as shown in the figure.
Make sure the DC Motor is in "coding" mode.



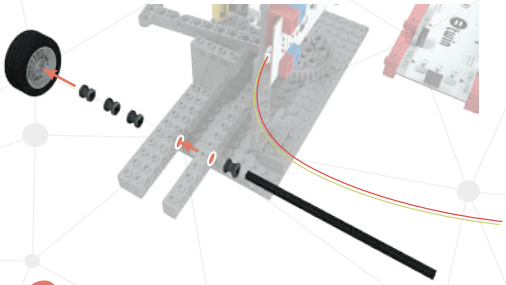
8 Connect one side of the Wire to D10/A10 output of Coding Module and other side to DC Motor.

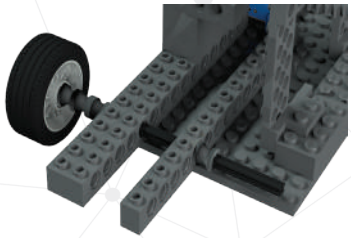


10 Attach the motor connection part to DC Motor and place the tire on top of it.

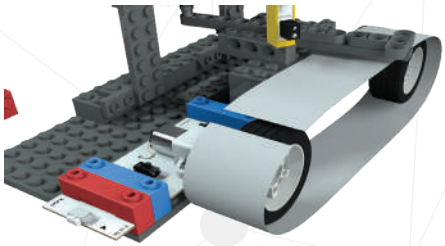


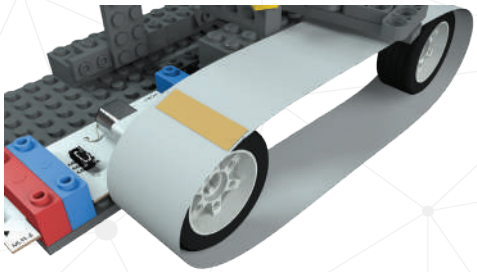
12 Mount the Signal Conductors in front of Proximity Sensors and connect to D4/A6 and D12/A11 inputs of Coding Module. Mount sensor number 1 on DC Motor. Mount sensor number 2 on building block.
Make sure the Proximity Sensor number 1 is in mode "a" and Proximity Sensor number 2 in mode "b".





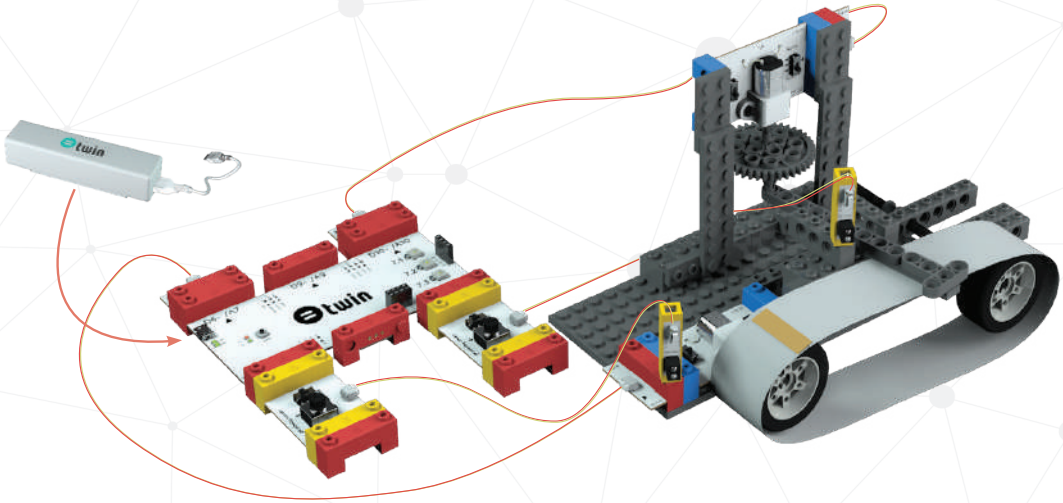
13 Pass the 12cm shaft through the fifth hole of 1x16 technical block and attach 4 pcs small pulleys at their ends as shown in the figure. Pass the tire to the shaft.





14 Piece together the smart manufacturing line paper on the tires and fix by the help of tape. The paper should not be loose or too tight. Tape the paper from the overlapping point and join it.

NOTE: **Prepare the smart manufacturing line paper by yourself!**



Prepare black and white materials, watch the smart manufacturing line differentiate them.

TWING DISPLAY

READ THE QR CODE, START CODING

How Does It Work?

Proximity Sensor sends out signals when the infrared rays reflect back to its receiver. Since white material passing in front of it reflects white infrared rays, the Proximity Sensor detects the presence of a product in front of it. Since black material absorbs infrared rays, the ray does not reflect back and Proximity Sensor acts as if there is no obstacle in front of it.

For Curious Ones

In Smart Manufacturing Line experiment, you made a small part of a serial manufacturing line. So, when and who found the first serial assembly line? In 1913, Henry Ford 1913 established the first serial assembly line for production of Ford vehicles. He reduced the production time of a car from 12,5 hours to 1,5 hours. And at the same time the automobile prices were decreased by 1/3.

REAL LIFE EXAMPLES

Serial Assembly Lines

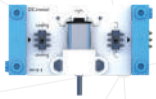
MAKE YOUR TRUCK READY TO GO

15 MIN EXPERIMENT DURATION
MEDIUM LEVEL

+

Required Modules


Coding Module

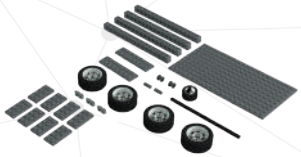

DC Motor x2


Wire x2


Ford F Max Truck Cabin

Additional Materials


Ball Caster

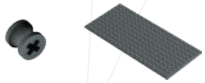

Building Blocks


Double-Sided Tape

Building Blocks


1x16 Perforated Technical Block 4 pcs

2x8 Thin Block 2 pcs


Small Pulley 2 pcs

10x20 Thin Block 1 pc


1x2 Thin Block 1 pc

2x4 Thin Block 8 pc

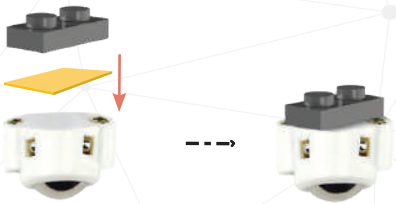

12 cm Shaft 1 pc

Motor Connection 2 pc

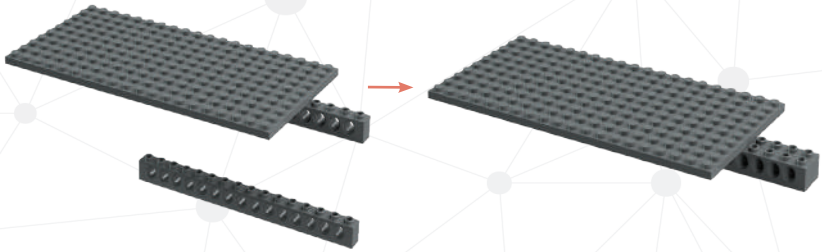

Tire x4

The truck you are going to prepare includes the parts you will use in Remote Controlled Truck, Autonomous Truck and Line Following Truck experiments. Use different modules and use your truck in different experiments!

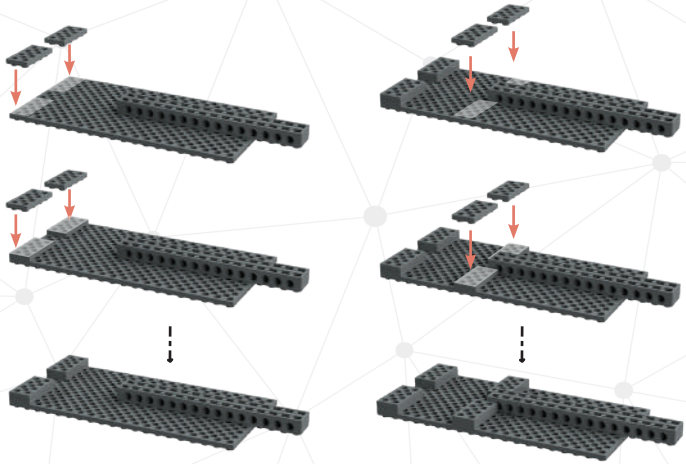
Project Steps



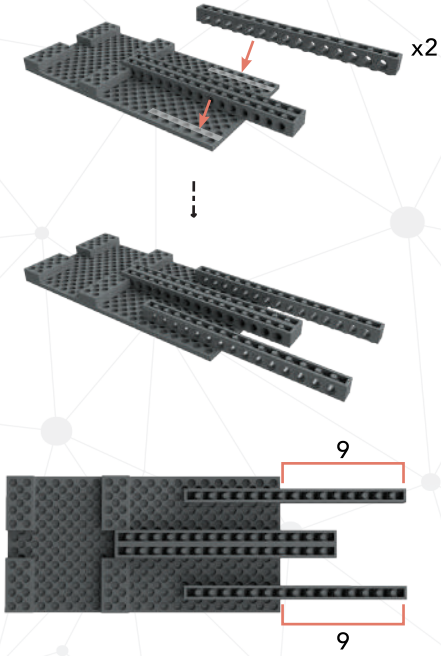
1 Tape the ball caster and 2x1 thin block with double-sided tape.



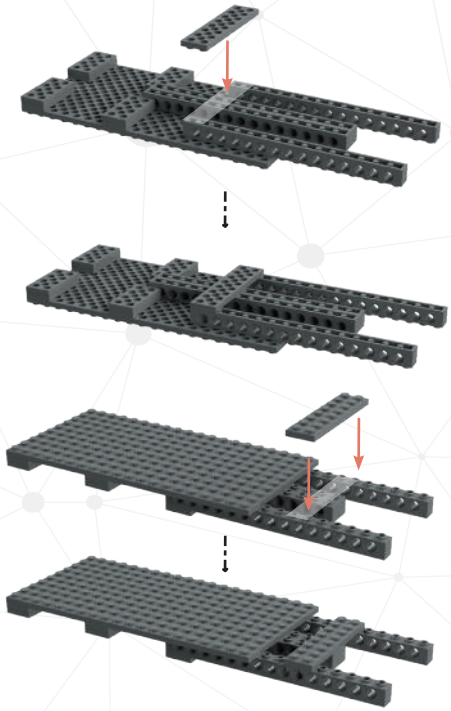
2 Mount 2 pcs 1x16 technical blocks on 10x20 thin floor block as shown in the figure.
Make sure 4 pcs pawls of technical blocks remain outside.



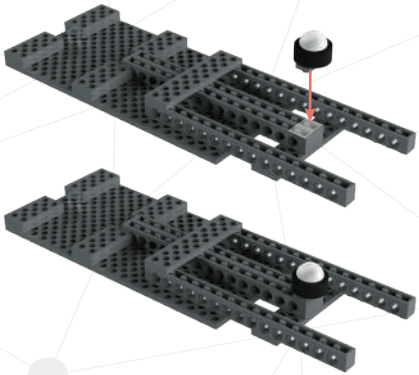
3 Mount 8 pcs 2x4 thin blocks under 10x20 thin floor block as shown in the figure.



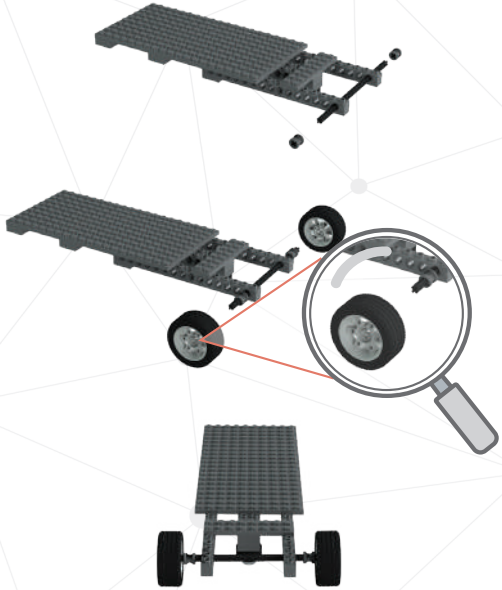
4 Combine 2 pcs 1x16 technical blocks with 10x20 thin floor block so that 9 pcs pawls remain outside.



5 Add 1 pc 2x8 thin block under the technical blocks, and the other on top of them.

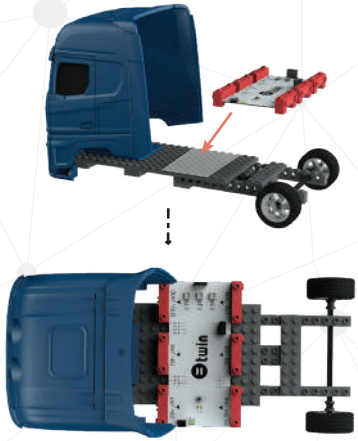


6 Place the ball caster at the end of technical blocks in the middle.



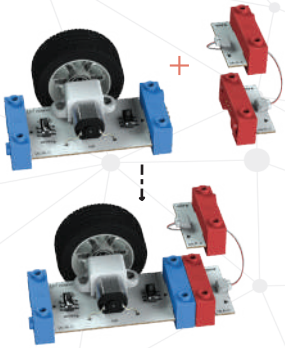
7 Add the tires and pulleys to both ends of the shaft. Make sure the star rim part of the tires remains inside.

8 Here is the most important step! Mount Ford F-Max truck cabin on thin floor block as shown in the figure.

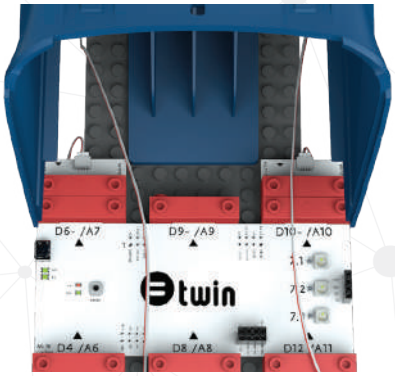


9 Place the coding module to thin floor block as shown in the figure. Make sure the Twin text on the module is positioned as shown in the figure.

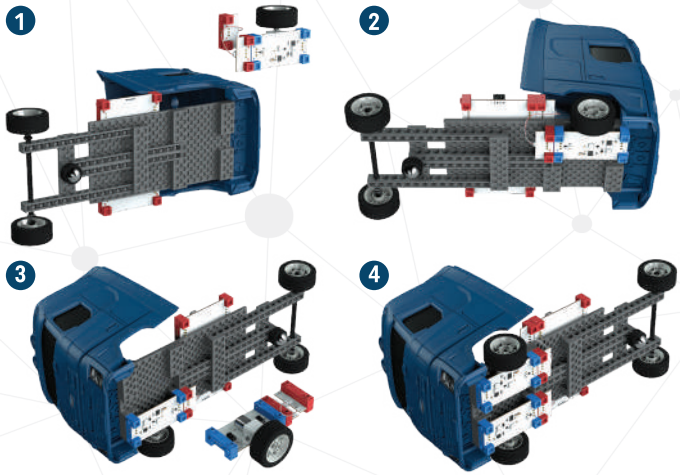
10 Connect first the DC Motor connection part, then the tires to the shafts of right and left DC Motor shafts. Make sure the star rim part of the tires remains outside.



11 Combine DC Motor modules with the Wires.



12 Connect the Wires to D6/A7 and D10/A10 outputs of coding modules as shown in the figure.



13 Place the Wires and DC Motor modules under the thin floor block as shown in the figure.

NOTE: Connect the right DC Motor onto the right side of cabin, left DC Motor to the left side of the cabin.

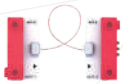
REMOTE CONTROLLED TRUCK

30 MIN EXPERIMENT DURATION
MEDIUM LEVEL

Required Modules


Coding Module


DC Motor


Wire x2

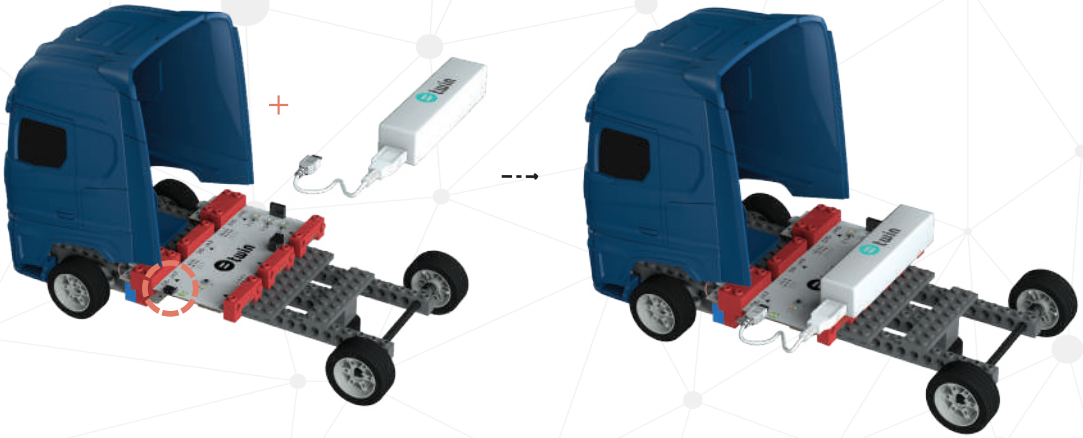

Powerbank


USB Cable

Additional Materials


Truck


Twinner App

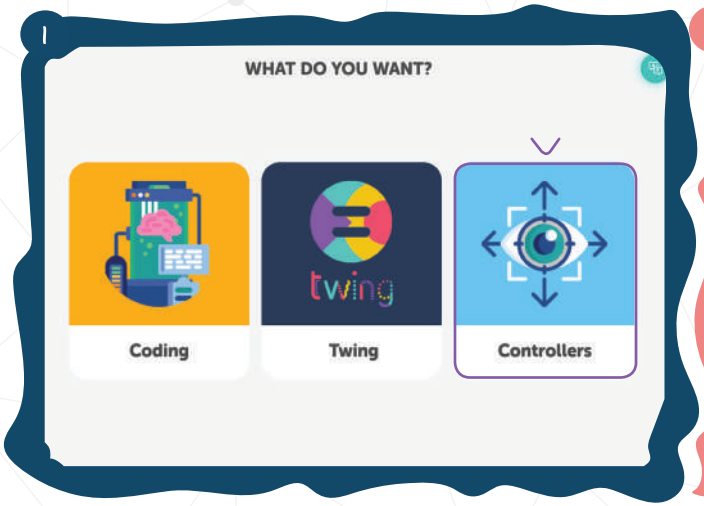


Connect the Powerbank to Coding Module as shown in the figure and mount it on top of the modules.
Make sure the DC Motors are in "coding" mode.

TWINNER DISPLAYS

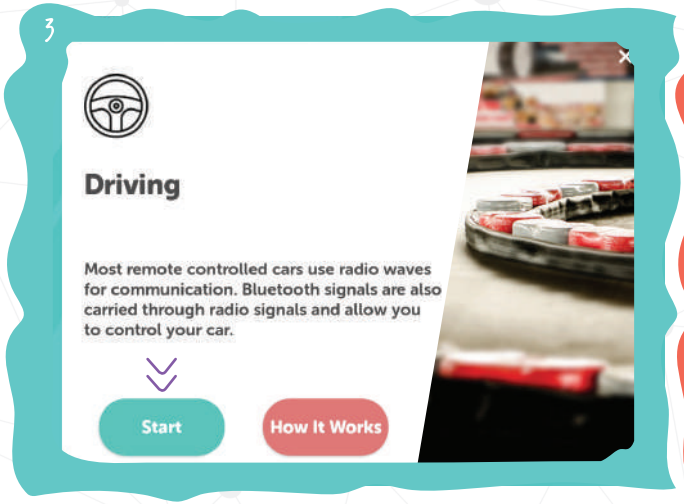
READ THE QR CODE,
START DRIVING THE TRUCK

Time to control your vehicle! Download Twinner application and start controlling your vehicle! Remember, safety first!

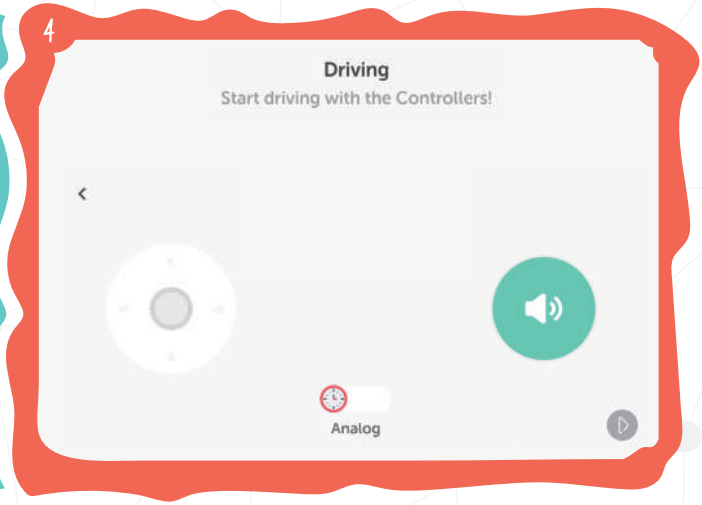


Touch the “Control” tab in the main screen of Twinner App.

Select the “Driving Mode”



Touch the “Start” option

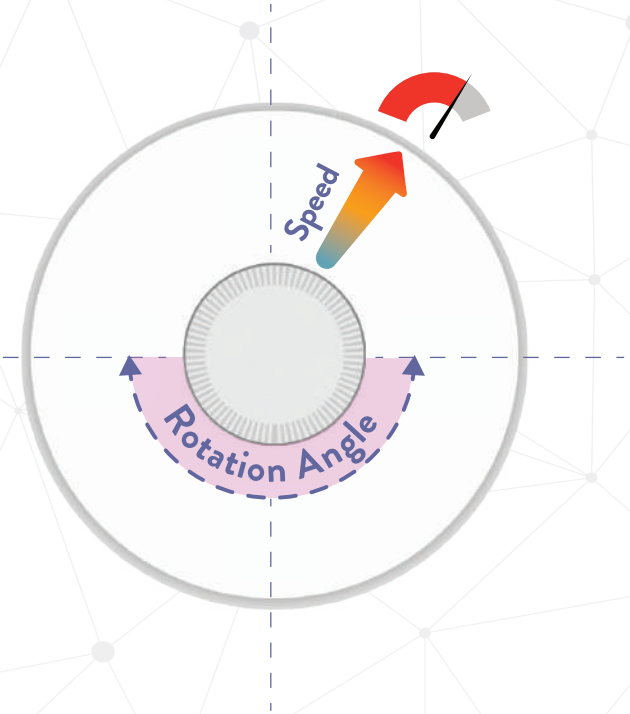


Now you are ready, the experienced driver is on the road!

How Does It Work?

The controller on mobile phone display allows you to adjust both speed and direction of the vehicle. According to the position you arrange for the round button, it sends 2 information to the coding module via Bluetooth connection.

Speed information adjusts the rotation speed of DC Motors, that is the speed of the truck. And the direction information is sent as angle information. Coding module decides which DC Motor should rotate with which speed in that direction. It accelerates or decelerates DC motor accordingly. Did you realize that right tire of the truck decelerates while turning right?

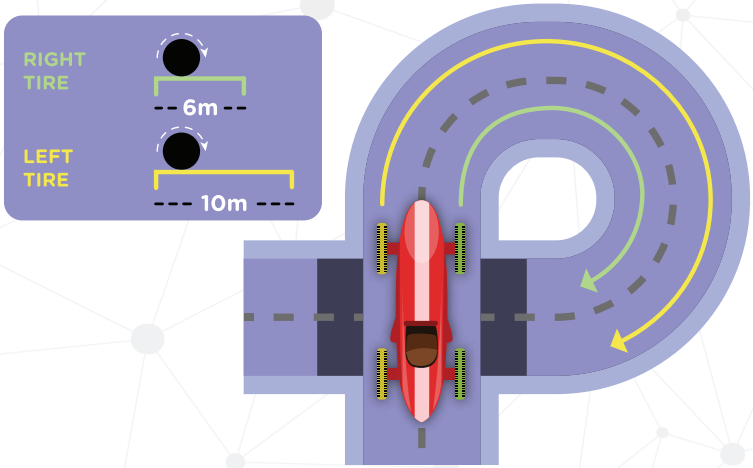


For Curious Ones

In the first four-wheel vehicles, it was not possible to control the rotation speed of tires separately. That's why the vehicles had problems while turning.

While the right tires of a vehicle turning right cover less distance, left tires cover more distance at the same time. So, the tires on the right rotates less. For providing a better turning for the vehicles, the system called differential was found. With the effect of differential, rotation speed of tires was varied and the problem was solved.

Search the differentials, share what you have learned with #twinscience hashtag.



AUTONOMOUS TRUCK

40 MIN EXPERIMENT DURATION

ADVANCED LEVEL

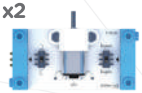
Required Modules

Coding Module

Proximity Sensor x2

Male-Female Jumper Cable

Signal Conductor x2



DC Motor x2

Wire x2

Ultrasonic Sensor

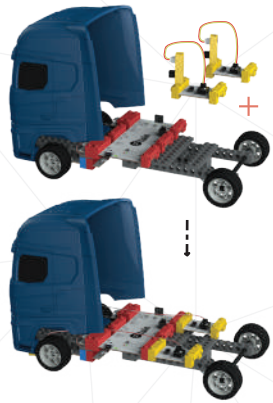
Additional Materials

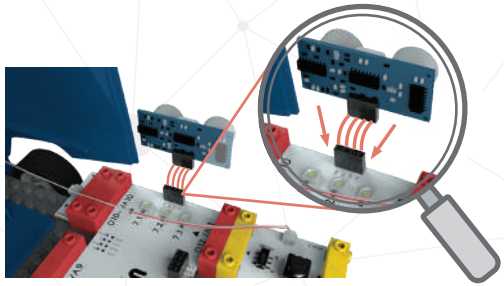
Powerbank

USB Cable

Truck

Twinner App





1 Connect the Proximity Sensors to D4/A6 and D12/A11 inputs of Coding Module. Change their directions as shown in the figure and attach them to the 2x1 inputs under thin floor block. **Make sure the Proximity Sensors are in mode "a" .**

2 Connect the powerbank to Coding Module as shown in the figure and attach on top of the modules.

3 Connect the pins on the outputs on top of ultrasonic sensor to the same inputs on Coding Module using the female-male jumper cables (VCC, Trig, Echo, GND).

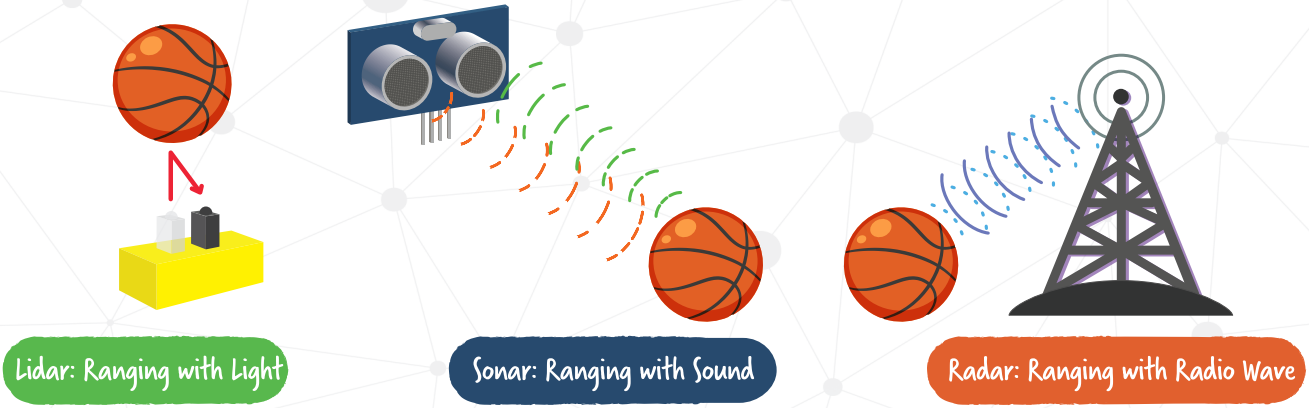
IMPORTANT NOTE: Connect the cables in order so that the sensor faces the direction shown in the figure. Wrong connections damage the circuit. Make sure you made the connection correctly as in the figure.

4 Place the ultrasonic sensor to the spaces in front of the cabin as shown in the figure.

How Does It Work?

In this experiment, you used both the Proximity Sensor and the Ultrasonic Sensor. So, what were their duties? You placed the Proximity Sensor so that it also sees the sides of the truck. And this allowed the truck to detect the obstacles on its right and left and proceed with the turning maneuvers.

Ultrasonic Sensor was used to stop the truck in case there is an obstacle from which the truck cannot escape. This way, you built a sensor system that can see all the obstacles in front of the truck.



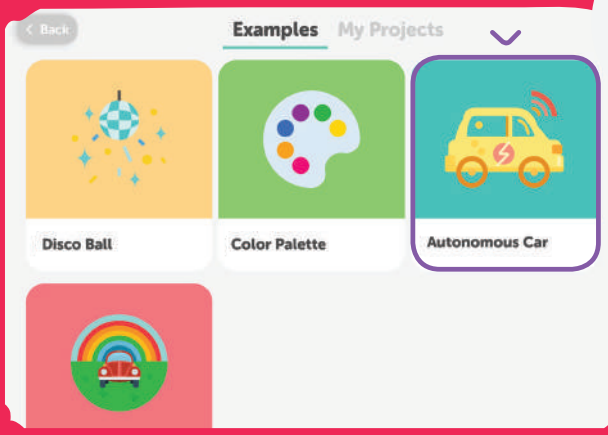
For Curious Ones

Autonomous vehicles detect the obstacles around them with 3 different methods.
Lidar (Light Detection and Ranging)
Sonar (Sound Navigation and Ranging)
Radar (Radio Detection and Ranging)
In this experiment, you made an autonomous truck using Lidar and Sonar sensors.
While Proximity Sensor works with Lidar principle, Ultrasonic Sensor works with Sonar principle.
Obstacles can also be detected with artificial intelligence. Cameras are used as sensors. The truck compares the images previously introduced to it with the images from the camera and avoids the obstacles.
Share different examples of uses of Lidar, Sonar, and Radar with #twinscience hashtag.

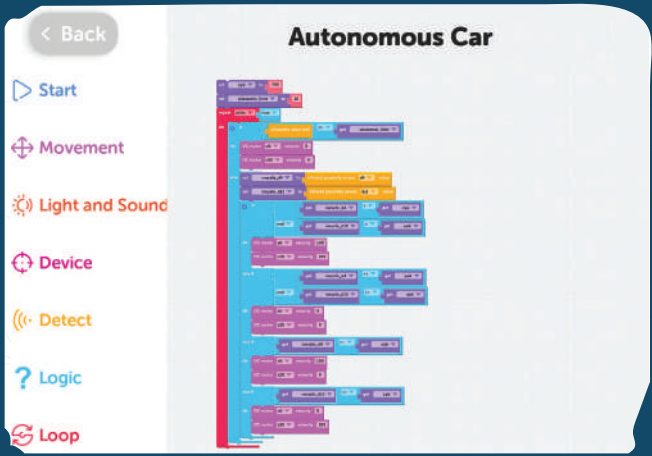
TWINNER DISPLAYS

READ THE QR CODE, START CODING

1



2

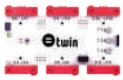


LINE FOLLOWING TRUCK

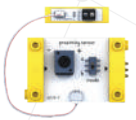
60 MIN EXPERIMENT DURATION

ADVANCED LEVEL

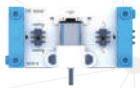
Required Modules



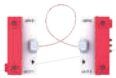
Coding Module



Proximity Sensor x2



DC Motor x2



Wire x2

2x2 Two Sided Connection 1 pc

Powerbank

USB Cable

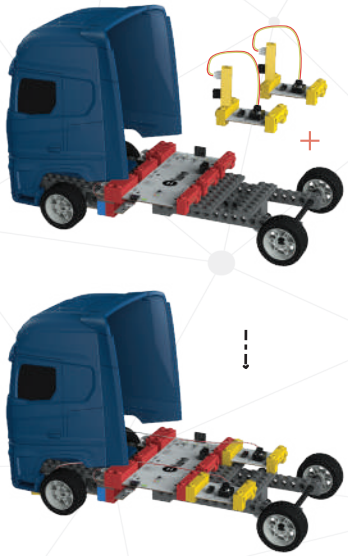
Additional Materials

Truck

Twinner App

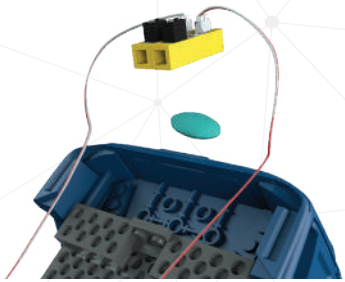
Black Tape

Sticky Dough

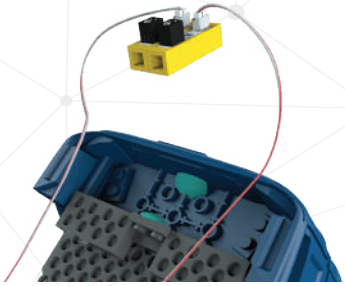


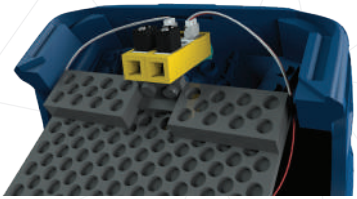
1 Connect Proximity Sensors to D4/A6 and D12/A11 inputs of Coding Module and make sure they are ˜n mode “a”.

2 Attach 1 pc 2x2 two-sided connection part to the most front part of 10x20 thin block as shown in the figure.



3 Stick 1 pc sticky dough to 2x2 two-sided connection part. Stick the other sticky dough to F-max cabin.





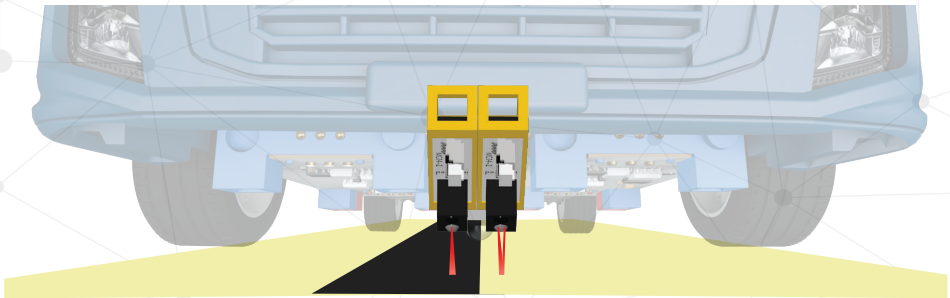
4 Stick the sensors on the sticky doughs as shown in the figure.
IMPORTANT NOTE: The angle of sensors is important. Make sure you have positioned the sensors with an angle of approximately 45 degrees.

5 Connect the Powerbank to Coding Module as shown in the figure and mount it on the modules.

IMPORTANT NOTE: Since the Proximity Sensors make ranging with light, they are adversely affected by ambient light and especially the sunlight. Make sure you don't try the Line Following Truck in sunny or very bright environments.

ATTENTION!

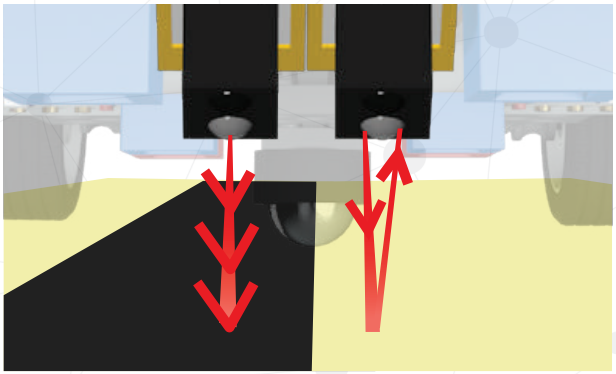
Line Following Truck was developed for the ones who are curious about coding. It is necessary to send line code to the Coding Module through computer. You can access the line code of Line Following Truck experiment and code uploading steps from **go.twing.io/linefollower**



How Does It Work?

The reason for an object to appear in color is the light it reflects. White light involves all colors in it. For example, an object you see in red color absorbs all colors and reflects only the red light. But how can an object be black? Black is seen when no light is reflected. Since black does not reflect light, it does not reflect infrared light as well.

2 pcs proximity sensors you placed under the car send the infrared rays to the black tape. Since the Proximity Sensor is in mode “a”, as long as no ray is reflected back, Proximity Sensor keeps on giving 1 signal. When the car is going to the left, the rays sent by the sensor on the left do not fall onto black tape. For this reason, the rays are reflected from the ground. And the Proximity Sensor thinks it has seen an obstacle and sends 0 signal. Transmitted 0 signal stops the motor on the right side of the car, the car turns right and keeps on following the black tape.



For Curious Ones

Normally the autonomous vehicles use camera to see the lanes. In this experiment, a vehicle following the line with Proximity Sensor was made. So, the Proximity Sensor is used for colour detection process. Areas of use of infrared sensors are very wide. With the logic of use here, it is possible to calculate the number of rotation of motors. Consider you placed a coding disc against the Proximity Sensor. When the disc sees the white area, the ray is reflected to the sensor against the disc and gives 1 signal. When it sees the black area, the ray does not reflect and gives 0 signal. In a disc with 4 black sections, when the sensor sees 4 black sections, it understands that the disc completed 1 tour. This way it will be possible to specify the exact position of the disc.

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Warnings

- This set contains chemicals and/or pieces that may be harmful in misuse. For proper use, please read the warnings inside the box and the entire booklet carefully.
- The box and the booklet contain important information and warnings. For proper use, keep the box and the booklet for future reference.
- This product contains small magnet(s). Swallowed magnets can stick together across intestines causing serious infections and death. Seek immediate medical attention if magnets are swallowed or inhaled.
- Twin modules contain small parts. DO NOT allow children under 3 years old to play with or near this product. - Choking Hazard
- Some of the Twin modules contain long cords. -Risk of suffocation.
- Do not connect Twin modules to an electrical socket or to a source of alternative current.
- Keep conductive materials away from sockets and the circuit.
- Turn the circuit off when not in use.
- Do not use Twin modules near water or other liquids. Do not use the modules inside a liquid and avoid spilling liquids on the modules.
- Do not use the modules in extreme conditions. Do not use the modules in very hot, very cold, very humid, dusty or sandy places.
- Make sure the modules are clean before using them. The magnets can stick to small metallic pieces and prevent modules from connecting.
- Make sure the connectors of the modules are clean if there are issues with modules' connections.
- Some modules may heat up due to how they are used. If the modules reach extreme temperatures reassess the circuit and stop using the overheated parts.
- Remove any broken or damaged modules from the circuit and stop using those modules.

Important Note: **Several projects in this kit involve the use of a scissors. These tools should be used ONLY under direct adult supervision and ONLY by children capable of using them safely.**

Electronic Waste

Warning! Pieces that have been marked with this symbol contain components which are harmful to nature and to people and should not be discarded alongside other waste. If discarded improperly, the process might cause harm and will be subject to legal punishment. These components should not be used incorrectly. It is forbidden to remove these electrical and electronic components from the toy or using a damaged product. These actions may be harmful.

Electrical and electronic waste must be collected separately and should be passed to designated waste collection sites. Alternatively, you can get in contact with your place of purchase and ask for return the product for disposal back to the shop when a similar product is purchased. Users of the product play a vital role in the collection and discarding of those which have completed their life cycle. For further information, contact your local authorities.

Battery Warnings 

The symbol on the right means that the battery should not be discarded alongside home waste due to its harmful and/or toxic contents. Batteries should be taken to the nearest recycling or waste collection station to be discarded. Dispose of all batteries in accordance with current regulations, by using the appropriate containers at an authorized recycling center or by returning them to the shop where they were purchased. Penalties are applied for incorrect disposal. For further information, contact your local authorities.

- Batteries are dangerous if swallowed; keep away from children.
- Pay attention to the battery's + and - poles when using
- The insertion and removal of batteries should be done with an adult's supervision.
- Do not short circuit the battery by connecting the ends.
- Remove batteries once they have run out
- Do not attempt to recharge non-rechargeable batteries
- Rechargeable batteries should be removed before being charged.
- Rechargeable batteries should be recharged with adult supervision
- Do not try to open the batteries
- Do not expose the batteries to high temperatures and fire. They may explode or leak
- Remove the batteries if the device will not be used for a long time
- Only use recommended batteries
- Discard used batteries carefully at designated disposals.
- Different types of batteries or new and used batteries are not to be mixed.

Cleaning the Modules

Only clean the Twin modules when they are not connected to electricity and only with a dry or slightly damp towel with isopropyl alcohol.

Frequently Asked Questions

- **One of the modules isn't working. What should I do?**
  Check if the module has been connected correctly. Clean the connectors as instructed in the guide.
  If it still isn't working, you can send an e-mail to **support@twinscience.com**
- **What is the recommended age for the Autonomous Vehicle Kit?**
  Because of the electronical and magnetic parts, 8+ age is recommended.
- **I have finished the sample projects in the booklet. Where can I find more sample projects?**
  You can access all project instructions, videos, and codes from the Twinner mobile app.
  Do not forget to check website, YouTube channel and social media account for more projects..
- **I am having trouble with sample projects in the booklet. How can I get support for the projects?**
  Check Twinner mobile app. You can find all projects' detailed videos and instructions in the app.
- **Where can I download the mobile app?**
  You can download it from App Store or Google Play Store.
  Do not forget to create an account to use the application fully.
- **Can I connect my Twin modules with LEGO® bricks?**
  Twin is fully compatible with LEGO® bricks. You can use them to create as many projects as you wish.
- **Which batteries are recommended?**
  9V alkaline batteries are recommended. Make sure your batteries' quality is good.
- **What should I do if I run out of materials?**
  Take a look at "Don't Get Sad if You Run Out" part.

Contact Us

Feel free to reach us for your all questions, feedbacks and demands.
Reach us via e-mail: **support@twinscience.com**

33 Queen St, Office 2102,
London, EC4R 1AP, UK

Twin Yazılım Mühendislik Sanayi ve Ticaret A.Ş.
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