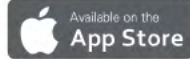
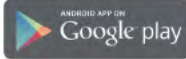


STEAM



Fostering DIY Ability and Programming Thinking

# Creative Robot

## Engineering Workshop



# Preface



In 1984, Comrade Deng Xiaoping, China's former great leader said that "the popularization of computers must start from the children". Computer education has gradually entered the eyes of Chinese people since then. Today, computers can be seen everywhere in our life. "Artificial intelligence-based programming education" is a product of the educational philosophy that advances with the times.

Q-scout is an intelligent educational robot that incorporates the concept of STEM education. It is also a key to unlocking children's computer thinking. This book aims to guide the children who like Q-scout to find their own key to open their door to computer thinking.

It contains explanations of the sensors installed in Q-scout, the use of custom programming in the app and new gameplays and functions that go beyond. We hope that kids create their own Q-scout through learning and have a unique buddy!





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# Introduce Q-scout

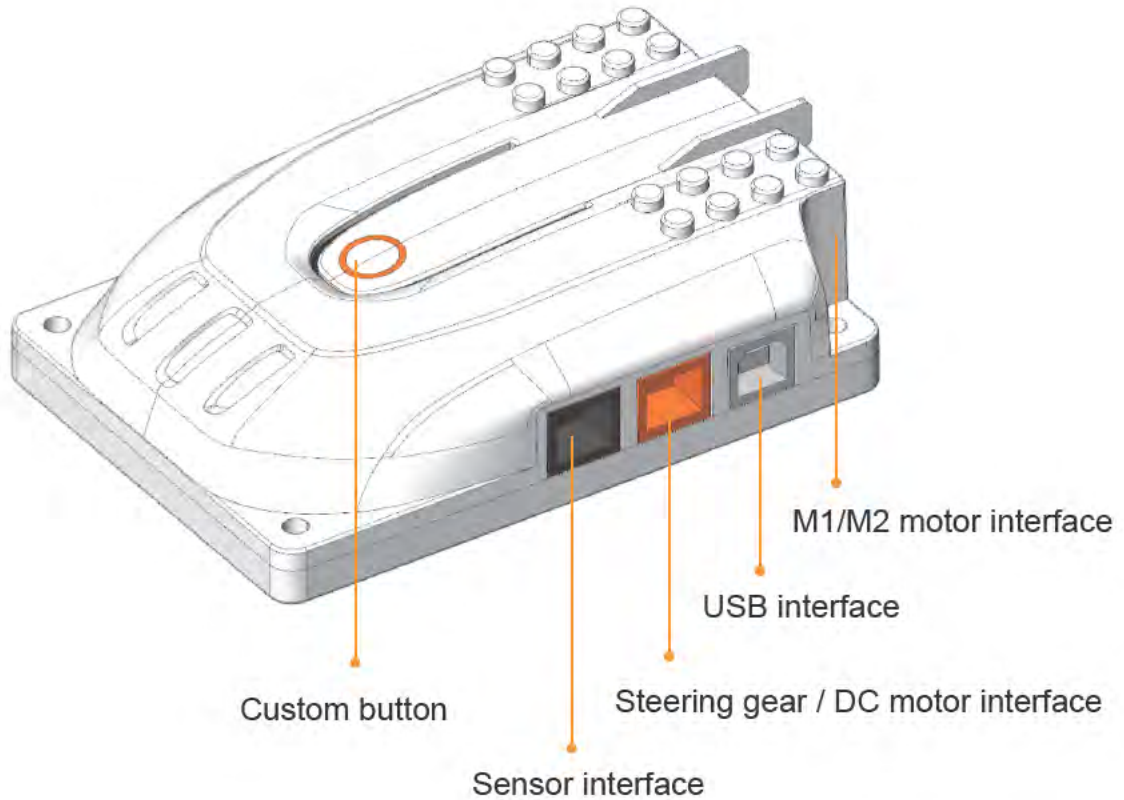


Q-scout is an intelligent robot that can emit colorful lights and play wonderful songs. The line tracking sensor installed on it allows it to travel along the line and become a little patrol guard ready at all times! There is also an ultrasonic sensor mounted on it that glows with colorful lights which can detect obstacles in front, making Q-scout prepared to avoid obstacles in advance. Next, let's check out this mysterious Q-scout!





# Learn about the programs



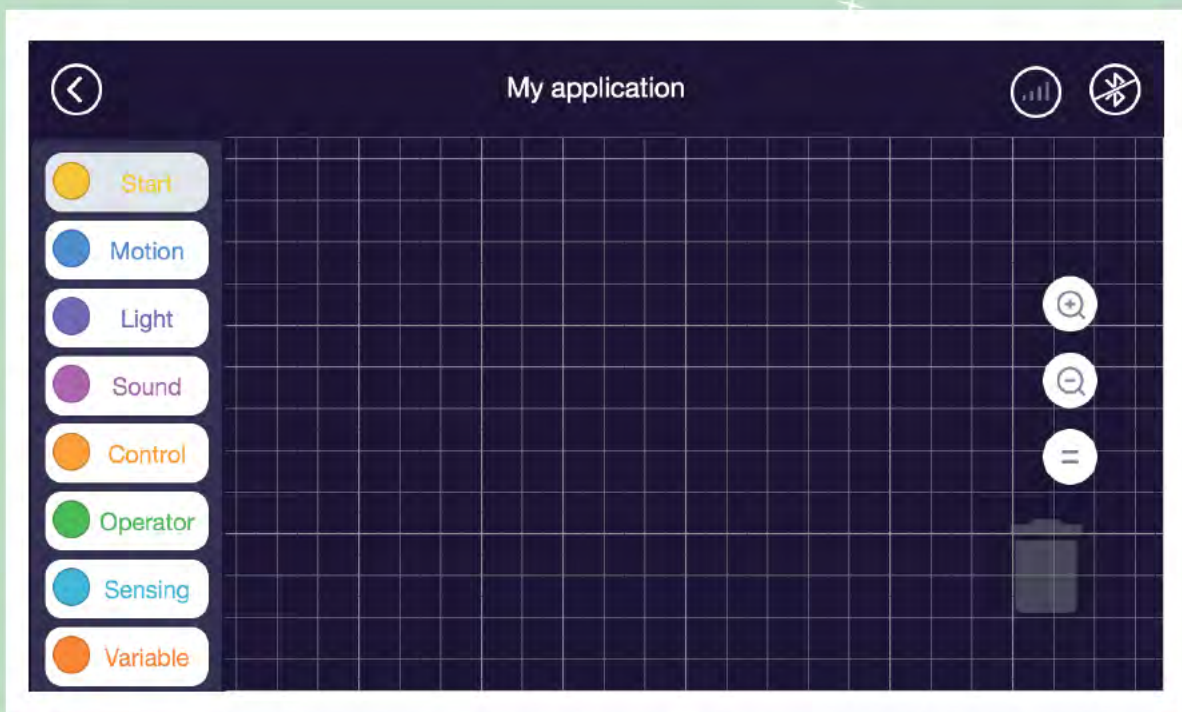
The motherboard is the Q-scout's brain with a Bluetooth module. After we connect the motherboard with the phone via Bluetooth, the commands are sent to the motherboard which then send the commands to each sensor and motor. It also incorporates colorful RGB lights, a buzzer that can make sounds and a small button that can be programmed freely.

# Learn about the programs



## Understand the programming interface

- 👉 **Function:** You can drag the module freely on the grid interface to edit the program and send the program to the motherboard via Bluetooth.
- 👉 **How:** Drag and drop the module on the left to edit the program; the first icon in the upper right corner is for Bluetooth connection through which you can connect the phone to the motherboard and send the edited program commands to the brain of Q-scout.




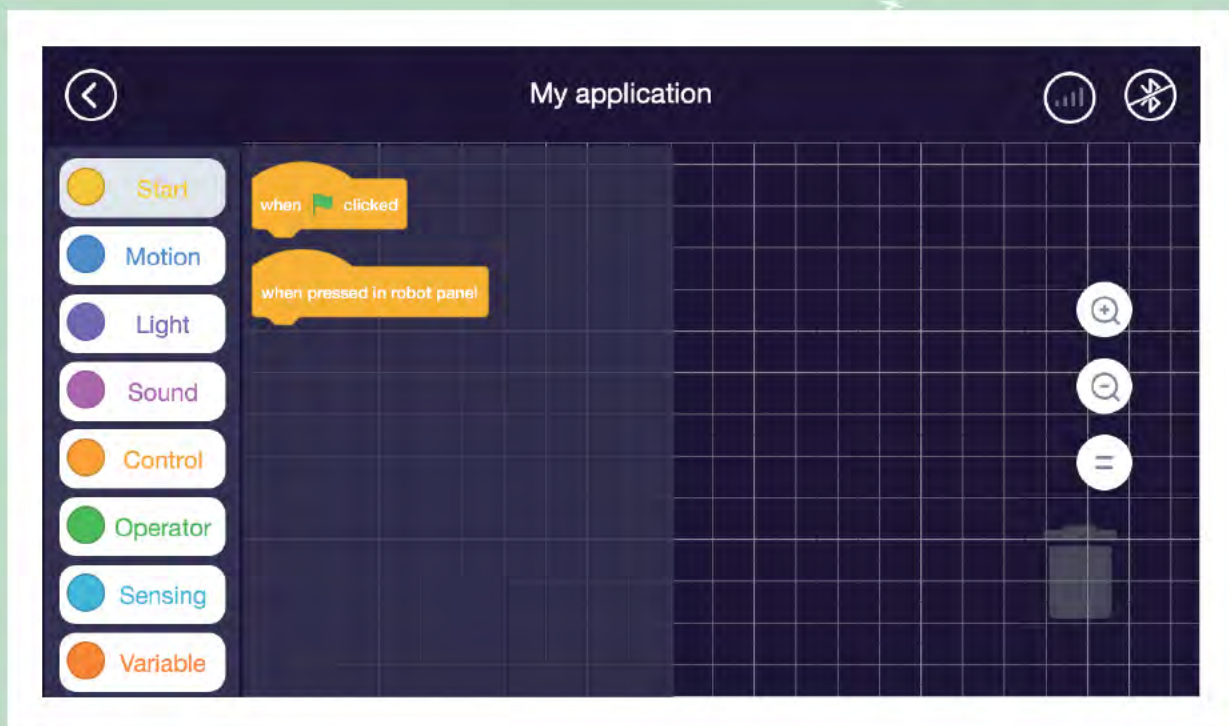


# Learn about the programs



## "Start" module

- Function: It contains two initial statement block for the program that must be added to the program.
- How: It can only be placed at the beginning of the program. The "When  is tapped" module starts the program when tapping the module on the phone; the "Press the button on the top of the motherboard" module starts the program when pressing the custom button on the motherboard. Drag the module to the program interface as needed.



# Learn about the programs



## "Motion" module

- Function: It contains the statement blocks that can control the rotation and stop of the motors connected to the motherboard M1 and M2 interfaces.
- How: M1/M2 are settings for the program start port. Forward/backward are settings to make the motor rotate clockwise/counterclockwise. Speed ( ) is to set the motor speed, and Speed (0) or "Stop moving" module are to set the stop. Insert the module into the initial statement block and set as needed.

The screenshot shows a programming interface with a dark blue background and a grid. On the left is a sidebar with colored buttons for 'Start', 'Motion', 'Light', 'Sound', 'Control', 'Operator', 'Sensing', and 'Variable'. The main workspace contains a script for 'My application' with the following blocks:

- Motor rotation left: 0 right: 0
- run forward at speed 0
- set motor M1 forward at speed 0
- set port 1 steering engine M1 corner 1
- set port port 1 external motor speed 0
- Stop exercising

On the right side of the workspace, there are icons for zooming in (+), zooming out (-), and a trash can.

<Note: Q-scout's motor is easier to start running at a speed above 50>



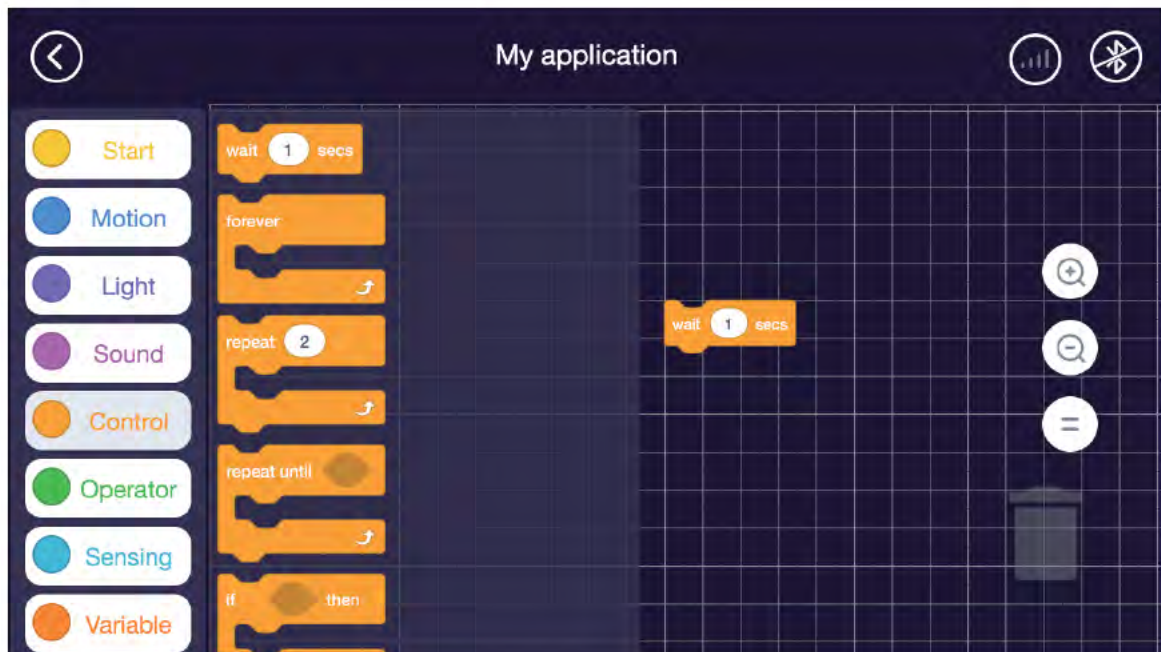


# Learn about the programs



## "Control" module

- 📁 Function: It contains a statement block that sets the execution time for the next program: "Wait () second(s)".
- 📁 How: Insert it between the previous program and the program, and set the start time of the next program. Insert the module into the initial statement block and set as needed.



# Try it yourself



Try setting it up and see what happens to your Q-scout!

The screenshot shows a programming environment titled "My application". On the left is a sidebar with categories: Start (yellow), Motion (blue), Light (purple), Sound (purple), Control (orange), Operator (green), Sensing (light blue), and Variable (orange). The main workspace contains a script starting with "When green flag clicked", followed by "set motor M1 forward at speed 50", "wait 10 secs", and "Stop exercising". A separate block for "Motor rotation left: 0 right: 0" is visible above the main script. On the right side of the workspace are zoom in (+), zoom out (-), and reset (=) icons, along with a trash can icon.





# Let's dance



My application

- Start
- Motion
- Light
- Sound
- Control
- Operator
- Sensing
- Variable

```
when clicked
  set motor M1 forward at speed 50
  wait 1 secs
  Stop exercising
  set motor M2 forward at speed 50
  wait 1 secs
  set motor M1 forward at speed 50
  set motor M2 forward at speed 50
  wait 2 secs
  Stop exercising
```

Navigation icons: +, -, =, trash



# What did you learn?



Motor interface

M1/M2 (forward)  
At the speed of (0)

Execution time of the  
next program

M1/M2

Motor stops

Wait () second(s)





Complete the evaluation



# Little Racer



Racing on the track at high speed is a very dangerous thing, especially if the track is crooked, but it is an excellent way to let the driver show his outstanding driving skills. Now let's learn how to be a racer and direct our Q-scout in race games!





# Stories in life



We sometimes see cars with "2WD" or "4WD" marks. Actually, "2WD" is short for 2-wheel drive which means 2 wheels are connected to the engine to provide power, while "4WD" is for 4-wheel drive which means 4 wheels are connected to the engine to provide power. In general, 4WD vehicles require more energy than 2WD ones. But in a severe environment, it's harder for 2WD vehicles to drive than 4WD ones.

Many commonly seen cars are generally 2WD. Some are front-wheel drive and some are rear-wheel drive. 2WD vehicles are driven by the two wheels connected to the engine. For the rest wheels, if it's a front-wheel drive car, they are pulled forward, if it's a rear-wheel drive car, they are pushed forward. And our 2WD Q-scout is front-wheel drive.



<Snowland-crossing vehicle>

# Learn about the programs



## Q-scout moves forward

- 📁 Function: Set the rotation direction of the left and right motors to make Q-scout move forward.
- 📁 How: Adjust the left and right motor speed to an identical value between 50 and 100.

The screenshot shows the Scratch programming environment with a script titled "My application". The script consists of the following blocks:

- Start** button
- Motion** category: "run forward at speed 0"
- Motion** category: "set motor M1 forward at speed 0"
- Motion** category: "set port 1 steering engine M1 corner 1"
- Motion** category: "set port port 1 external motor speed 0"
- Motion** category: "Motor rotation left: 50 right: 50"
- Control** category: "Stop exercising"

The "Motor rotation left: 50 right: 50" block is highlighted in blue. The interface also shows a left sidebar with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. On the right, there are zoom and search icons.



# Learn about the programs



## Q-scout turns right

- Function: Set the rotation direction of the left and right motors to make Q-scout turn right.
- How: Adjust the left motor speed to a value between 50 and 100 and the right motor speed to between -50 and -100. The values are in the same number and one is positive and the other negative.

The screenshot shows the LEGO Mindstorms software interface titled "My application". On the left, there is a vertical menu with categories: Start (yellow), Motion (blue), Light (purple), Sound (purple), Control (orange), Operator (green), Sensing (blue), and Variable (orange). The main workspace contains a sequence of blocks:

- A "Motor rotation left: 0 right: 0" block.
- A "run forward at speed 0" block.
- A "set motor M1 forward at speed 0" block.
- A "set port 1 steering engine M1 corner 1" block.
- A "set port port 1 external motor speed 0" block.
- A "Stop exercising" block.
- A "Motor rotation left: 50 right: -50" block.

On the right side of the workspace, there are zoom controls (+, -, =) and a trash icon.

# Learn about the programs



## Q-scout turns left

- Function: Set the rotation direction of the left and right motors to make Q-scout turn left.
- How: Adjust the left motor speed to a value between -50 and -100 and the right motor speed to between 50 and 100. The values are in the same number and one is positive and the other negative.

The screenshot shows the LEGO Mindstorms software interface for a program titled "My application". The interface includes a left sidebar with category buttons: Start (yellow), Motion (blue), Light (purple), Sound (pink), Control (orange), Operator (green), Sensing (light blue), and Variable (red). The main workspace contains a sequence of blocks:

- A "Motor rotation left: 0 right: 0" block.
- A "run forward at speed 0" block.
- A "set motor M1 forward at speed 0" block.
- A "set port 1 steering engine M1 corner 1" block.
- A "Motor rotation left: -50 right: 50" block.
- A "set port port 1 external motor speed 0" block.
- A "Stop exercising" block.

On the right side of the workspace, there are zoom controls (+, -, =) and a trash can icon.



# Try it yourself



Try setting it up and see what happens to your Q-scout!

A screenshot of the Scratch 'My application' script editor. The interface has a dark blue background with a grid. On the left, there is a sidebar with category buttons: Start (yellow), Motion (blue), Light (purple), Sound (purple), Control (orange), Operator (green), Sensing (light blue), and Variable (orange). The main workspace contains a script starting with a 'when clicked' event block. The script consists of the following blocks in order:

- Motor rotation left: -50 right: -50
- wait 5 secs
- Motor rotation left: 50 right: 50
- wait 3 secs
- Motor rotation left: -50 right: 50
- wait 3 secs
- Motor rotation left: 50 right: -50
- wait 2 secs
- Stop exercising

On the right side of the workspace, there are icons for zooming in (+), zooming out (-), and a trash can.

# Game competition



Drive along the yellow line from the starting line to the finishing line and see who is the fastest Q-scout racer!



<Map for reference only>



# What did you learn?



Write down what kind of functions a future car in your mind should have.





Complete the evaluation





# Little Musician



Besides turning into a powerful racer, the magical Q-scout can become a great musician to play the music in our hearts. Now let's direct Q-scout to come up with a wonderful song!



# Stories in life



It's believed that everybody has their own favorite songs, instruments and singers whose concerts they want to go watch. Common instruments in our life include piano, guitar, etc. What are the differences between them?

A piano is a played instrument that consists of keys and metal-string soundboard. The performer presses the keys on the keyboard which touch the small felt-wrapped hammers in the piano, and the hammers then tap on the steel-wire strings to make a sound. The piano needs regular care and maintenance to ensure unchanged tones.

A guitar is a plucked string instrument that consists of only six strings. The performer plucks the strings to cause vibration which makes the sound, and by pressing different positions on the strings, different sounds can be made.



<Guitar-playing kid>



# Learn about the programs



## "Light" module

- Function: It contains command modules for adjusting on-board light color, brightness, and saturation.
- How: Place it below the initial statement block. "Double lamp/left lamp/right lamp" can be used to set which lamp is on. The color of light can be directly set to "red, yellow, green". You can set values in "red (), green (), blue ()" to change the concentration of the three primary light colors to create more beautiful colors. You can also set the brightness and saturation of different light colors to make Q-scout brighter and cooler.

The screenshot shows a Scratch script for a project titled "My application". The script is as follows:

```
set # double light in LED panel to color red  
set # double light in LED panel red 205 green 92 blue 92  
set # double light in LED panel to color  
set # double light in LED panel to color  
show drawing port 2 draw 0  
show drawing port 2 draw a  
show drawing port 2 draw h  
show drawing port 2 draw o  
show drawing port 2 draw u
```

# Learn about the programs



## "Sound" module

- 📁 Function: It contains a module that enables the buzzer to make a sound in various pitches and beats: "Play tone () at the beat of ()".
- 📁 How: Place it below the initial statement block, and arrange "Tone ()" and "Beat ()" in sequence to create pleasant music.

The screenshot shows the Scratch programming environment. The title bar reads "My application". On the left, there is a sidebar with various module categories: Start (yellow), Motion (blue), Light (purple), Sound (pink), Control (orange), Operator (green), Sensing (light blue), and Variable (dark orange). The main workspace is a dark blue grid. A script area on the left contains a sequence of eight "Play note on" blocks, each with a different note (C2, C3, C4, C5, C6, C7, C8) and a "beat" of "Half". A single "Play note on" block (C2, Half) is also placed on the grid. On the right side of the grid, there are three circular icons: a magnifying glass, a search icon, and an equals sign. A trash can icon is also visible at the bottom right of the grid.







# Try it yourself



Try setting it up and see what happens to your Q-scout!

The screenshot shows the Scratch workspace titled "My application". On the left is a sidebar with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains a script starting with a "when clicked" event block. The script blocks are:

- set # double light in LED panel to color red
- wait 1 secs
- set # double light in LED panel red 205 green 92 blue 92
- wait 1 secs
- set # double light in LED panel to color yellow
- Play note on C2 beat Half
- Play note on C3 beat Half
- Play note on C4 beat Half
- Play note on C5 beat Half
- Play note on C6 beat Half

On the right side of the workspace, there are icons for zooming in (+), zooming out (-), and a trash can icon.



# Let's compose a song



My application

when clicked

- Play note on C4 beat Half
- Play note on D4 beat Half
- Play note on E4 beat Half
- Play note on C4 beat Half

wait 0.1 secs

- Play note on C4 beat Half
- Play note on D4 beat Half
- Play note on E4 beat Half
- Play note on C4 beat Half

wait 0.1 secs

Start Motion Light Sound Control Operator Sensing Variable

My application

- Play note on E5 beat Half
- Play note on F5 beat Half
- Play note on G5 beat Whole
- Play note on E5 beat Half
- Play note on F5 beat Half
- Play note on G5 beat Whole

Start Motion Light Sound Control Operator Sensing Variable



# What did you learn?



Check out who can first play Twinkle Twinkle Little Star with Q-scout!





Complete the evaluation





# Get out of the Maze



Getting out of a maze is a very difficult game. It has very high requirements for our memory, observation and logic ability. Now let's try to cross the maze with our good partner Q-scout!



# Stories in life



For average people, a maze is mysterious and a manifestation of the ancient wisdom and can only be seen in uninhabited places in movies. Besides mazes, the mysterious ancient Egyptian pyramids are better embodiment of ancient wisdom.

Called one of the "eight major architectural Wonders of the world", pyramids can be found throughout Egypt and the Americas. The enormous architectural planning, heavy construction materials, exquisite channel design and the perfect combination of mathematics and architectural design all show the wisdom of the people in ancient times.



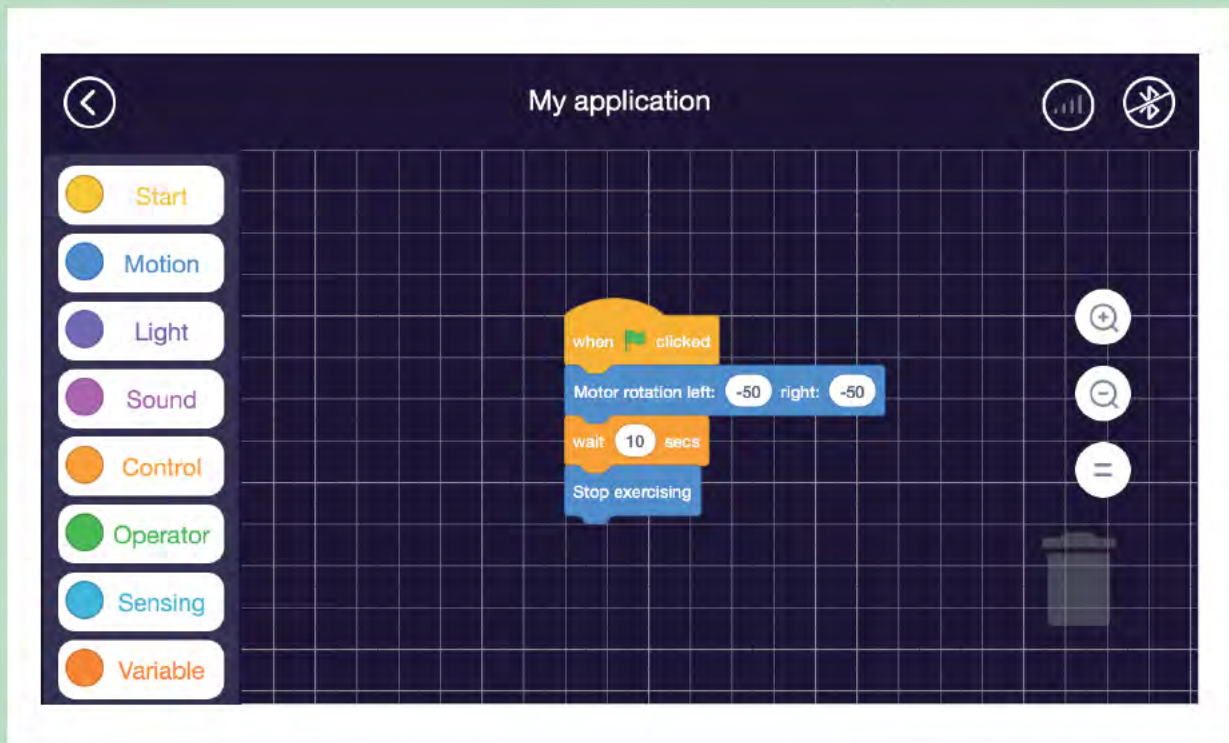


# Learn about the programs



## Set straight travel distance

- How: Set the motor speed and running time to control the travel distance.
- Usage: Set the left and right motor speed to the same value between 100 and 50 or between -100 and -50. Make the running time for both motors identical to allow straight travel. The speed and time can be set according to the actual distance.



# Learn about the programs



## Set travel distance for left and right turns

- How: Set the motor speed and running time to control the travel distance.
- Usage: Set the left and right motor speed to values in the same number between 100 and 50 or between -100 and -50 (one positive and one negative) to allow left and right turns. The speed and time can be set according to the actual distance.

The screenshot shows a programming interface titled "My application". On the left is a sidebar with category buttons: Start (yellow), Motion (blue), Light (purple), Sound (pink), Control (orange), Operator (green), Sensing (light blue), and Variable (red). The main workspace has a dark blue grid background. A script is assembled on the workspace:

- A yellow "when green flag clicked" block.
- A blue "Motor rotation left: 50 right: -50" block.
- An orange "wait 10 secs" block.
- A blue "Stop exercising" block.

On the right side of the workspace, there are control icons: a magnifying glass with a plus sign, a magnifying glass with a minus sign, an equals sign, and a trash can icon.







# Try it yourself



Now let's make our Q-scout get to move flexibly!

The screenshot shows a programming interface titled "My application". On the left is a sidebar with category buttons: Start (yellow), Motion (blue), Light (purple), Sound (purple), Control (orange), Operator (green), Sensing (light blue), and Variable (orange). The main workspace contains a sequence of blocks:

- When green flag clicked
- Motor rotation left: 50 right: 50
- wait 5 secs
- Motor rotation left: 50 right: -50
- wait 0.5 secs
- Motor rotation left: 50 right: 50
- wait 3 secs
- Motor rotation left: -50 right: 50
- wait 0.5 secs
- Motor rotation left: 50 right: 50
- wait 1 secs
- Stop exercising

On the right side of the workspace, there are icons for zooming in (+), zooming out (-), a reset (=) button, and a trash can icon.



# Get out of the maze



<Map for reference only>



# What did you learn?



Can you now control your Q-scout flexibly? Use it to get out of more mazes!





Complete the evaluation





# Little Musician



Express delivery is an indispensable part of our current era. For example, we can quickly send the carefully selected gifts to friends through express delivery. Now let's turn Q-scout into a cute courier and make it send gifts to friends!





Many new professions are emerging over time, and many other professions are falling. With the rapid development of the domestic express delivery industry, the distance for transactions and communications among people has been continuously shortened, and the cultural differences between the north and the south have also been reduced.

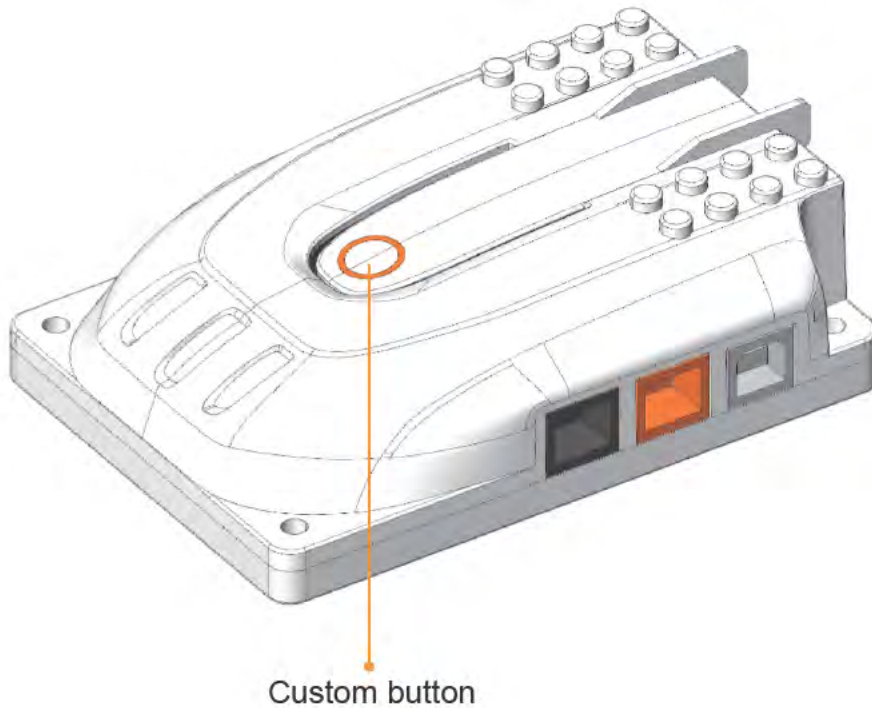
The express delivery vehicles we often see in life include trucks and motorbikes. What's more, as the demand for express delivery time becomes higher and higher, and the volume of shipments continues to increase, aircrafts are used for express delivery too.

An aircraft is lifted by the fixed wing and thrust by the propulsion device. Compared with other vehicles, it is not affected by the terrains, so the shortest path can be chosen and the speed can be increased.





# Learn about the electronic parts



Custom button

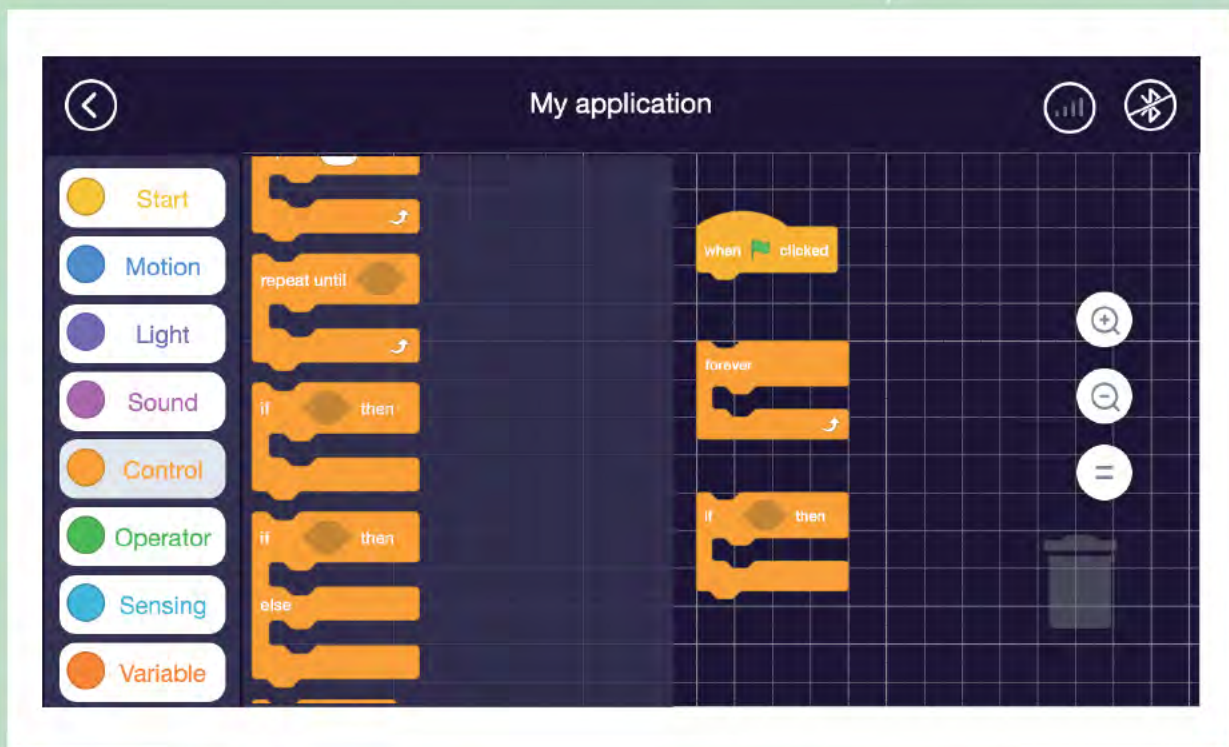
A custom button is a push switch that can be programmed to different functions. When the button is pressed, the circuit is turned on to run the program according to the requirements set by the function edited for the program.

# Learn about the programs



## "Control" module

- Function: It contains conditional statements such as "if... then..." and "if... then... and other..." as well as loop statements such as "Loop continuously", "Repeat execution () time(s)" and "Repeat execution until ()".
- How: Drag and drop the conditional statement module below the initial statement block and arrange them as needed; loop statement block is divided into infinite loop, limited loop and out-of-loop modules.





# Learn about the programs



## "Sensor" module

- 👉 Function: It contains the top button module.
- 👉 How: Drag and drop the top button module to the conditional statement module and place them below the start statement block.

The screenshot shows a programming interface titled "My application". On the left, there is a sidebar with various module categories: Start (yellow), Motion (blue), Light (purple), Sound (pink), Control (orange), Operator (green), Sensing (light blue), and Variable (red). The main workspace contains a script starting with a "when clicked" block, followed by a "forever" loop. Inside the loop, there is an "if" block with the condition "pressed in robot panel?". The "then" part of the if block contains a "Motor rotation left: 50 right: 50" block. Below the if block is a "wait 5 secs" block, and at the end of the loop is a "Stop exercising" block. On the right side of the workspace, there are icons for zooming in (+), zooming out (-), and a trash can.



# Try it yourself



Try setting it up and see what happens to your Q-scout!

The screenshot shows the Scratch 'My application' workspace. On the left is a palette with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains the following script:

```
when green flag clicked
  forever loop
    if pressed in robot panel? then
      Stop exercising
    else
      Motor rotation left: 50 right: 50
  wait 10 secs
```

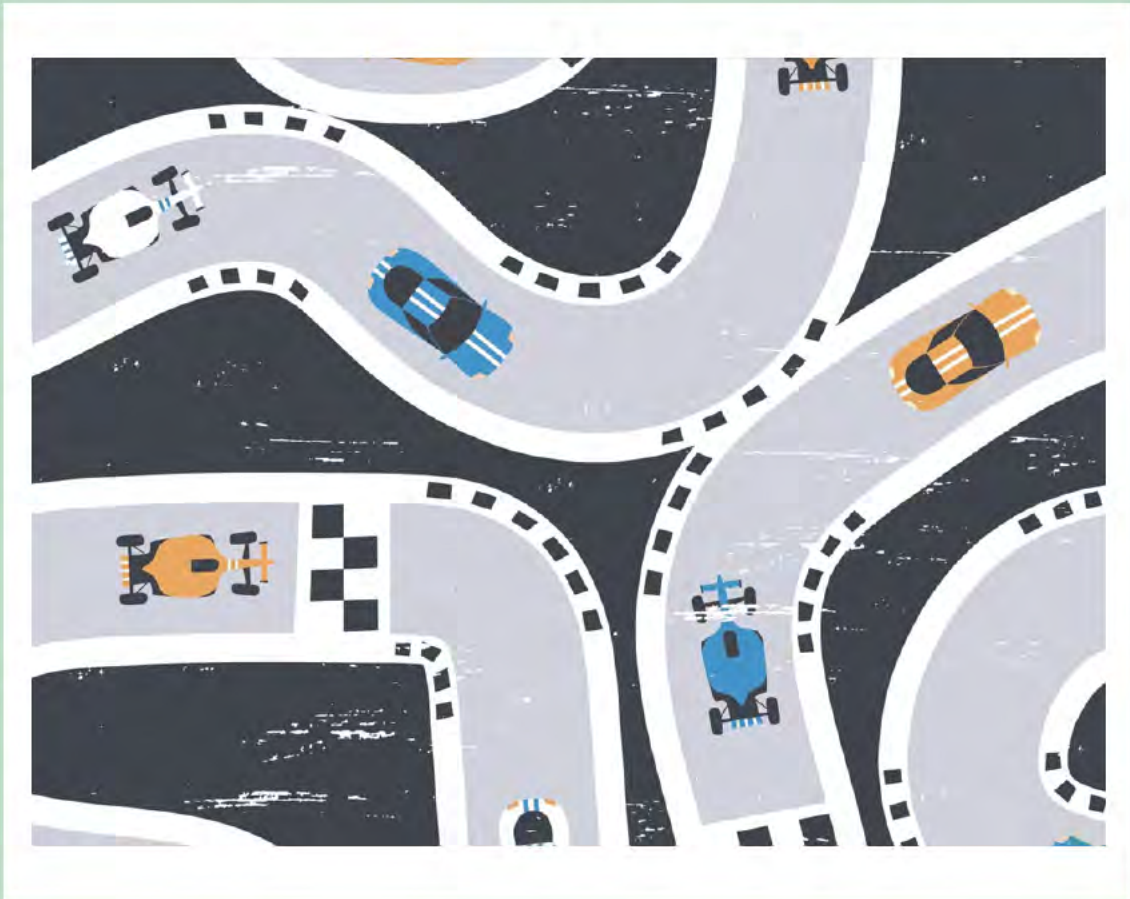
On the right side of the workspace, there are icons for zooming in (+), zooming out (-), and a trash can.



Let's join together



Join relay race with buddies! See which group of buddies are the fastest!





# What did you learn?



1. What does an infinite loop command do besides allowing the program to repeat execution?

Large empty green box for answer 1.



2. What is the difference between "if..." and "if... or..."?

Large empty green box for answer 2.





Complete the evaluation



# Patrol Guard



Patrol guards are indispensable in wars as they safeguard the troops when they rest. Now let's turn the magical Q-scout into a patrol guard who can patrol automatically and tirelessly!



# Stories in life



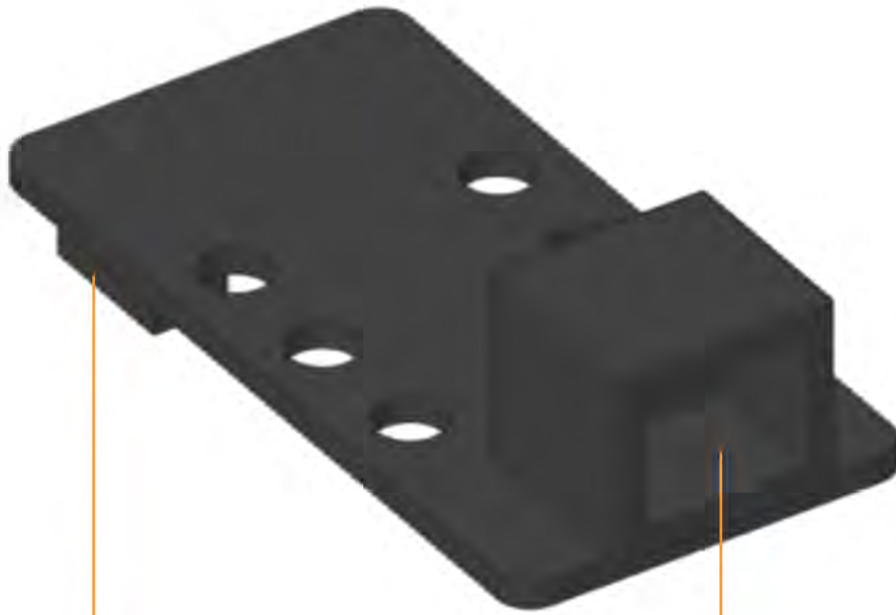
On the battlefield, patrol guards will patrol the camps. In our daily life, we can see more use of ubiquitous surveillance cameras to monitor important places. The videos captured by the cameras are transmitted via cables or over the network to the terminals connected to the cameras and displayed on the screens.

With the continuous development of surveillance cameras, they have become a non-negligible presence in social infrastructure, and moreover, they are everywhere in major cities. The era with surveillance cameras is totally transparent, which is a nightmare for criminals.





# Learn about the electronic parts



Line tracking sensor

Connector interface

A line tracking sensor recognizes the black lines on the ground and transmits information to the motherboard to make the robot travel along the black lines. Line tracking sensor is also widely used in daily life, such as elevator's sensor door and sensor faucet. With the aids of sensors, we can make life more convenient and safer.

It works by emitting light through the infrared emission tube. If the obstacle is black, it absorbs the light, so the infrared receiver tube will not get conducted; if the obstacle is white, it reflects the light, and the infrared receiver tube will get conducted.

# Learn about the programs



## "Control" module

- Function: It contains addition, subtraction, multiplication and division formulas and logical operation formulas.
- How: Drag and drop the calculation formula icon to the programming panel, and enter the values into the calculation formula to obtain the calculation result. Drag and drop the logical operation icon to the programming panel, drag and drop the calculation formula icon that obtains the calculation result to the logical operation icon, and put the logical operation result into the conditional statement as needed.



# Learn about the programs



## "Sensor" module

- Function: It contains line tracking sensor value, ultrasonic sensor values and motherboard button module.
- How: If line tracking sensor value = 0, it means that neither the left nor right infrared sensors receives light; if line tracking sensor value = 1, it means that the left infrared sensor receives light but the right infrared sensor doesn't receive light; if line tracking sensor value = 2, it means that the left infrared sensor doesn't receive light but the right infrared sensor receives light; if line tracking sensor value = 3, it means that both the left and right infrared sensors receive light. Drag the sensor value module into the calculation formula or logic formula, and then arrange them as needed.

My application

Start

Motion

Light

Sound

Control

Operator

Sensing

Variable

read ultrasonic sensor port 1

read line patrol sensor port 6

read right patrol sensor port 3

read sound patrol sensor port 2

read temperature patrol sensor port 1

read humidity patrol sensor port 1

pressed in robot panel?

when clicked

forever

if read line patrol sensor port 2 = 0 then

Motor rotation left: 50 right: 50



# Try it yourself



Try setting it up and see what happens to your Q-scout!

The screenshot shows a programming environment titled "My application". On the left is a palette with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains the following code blocks:

```
when clicked
  forever
    if read line patrol sensor port 2 = 0 then
      Motor rotation left: 50 right: 50
    if read line patrol sensor port 2 = 1 then
      Motor rotation left: -50 right: 50
    if read line patrol sensor port 2 = 2 then
      Motor rotation left: 50 right: -50
```

The screenshot shows the same programming environment. The code block from the previous screenshot is now partially obscured by a new block:

```
if read line patrol sensor port 2 = 3 then
  Stop exercising
```



# What did you learn?



Can you turn your Q-scout into a patrol guard?  
Try to make it go along this line!







Complete the evaluation





# Ultrasonic Warrior



We need brave soldiers to defend our homeland, and we never lack courageous soldiers on the battlefield. However, a great soldier needs not only to move forward bravely, but also to evade early in face of unconquerable enemies to reduce the losses.





# Stories in life



Those who fight on the battlefield are called soldiers, and the objects the warriors use on the battlefield are called weapons. With the development of science and technology, the weapons of soldiers on the battlefield are constantly changing. From swords and sticks to guns and cannons, their power is increasing, and their range is getting further and further.

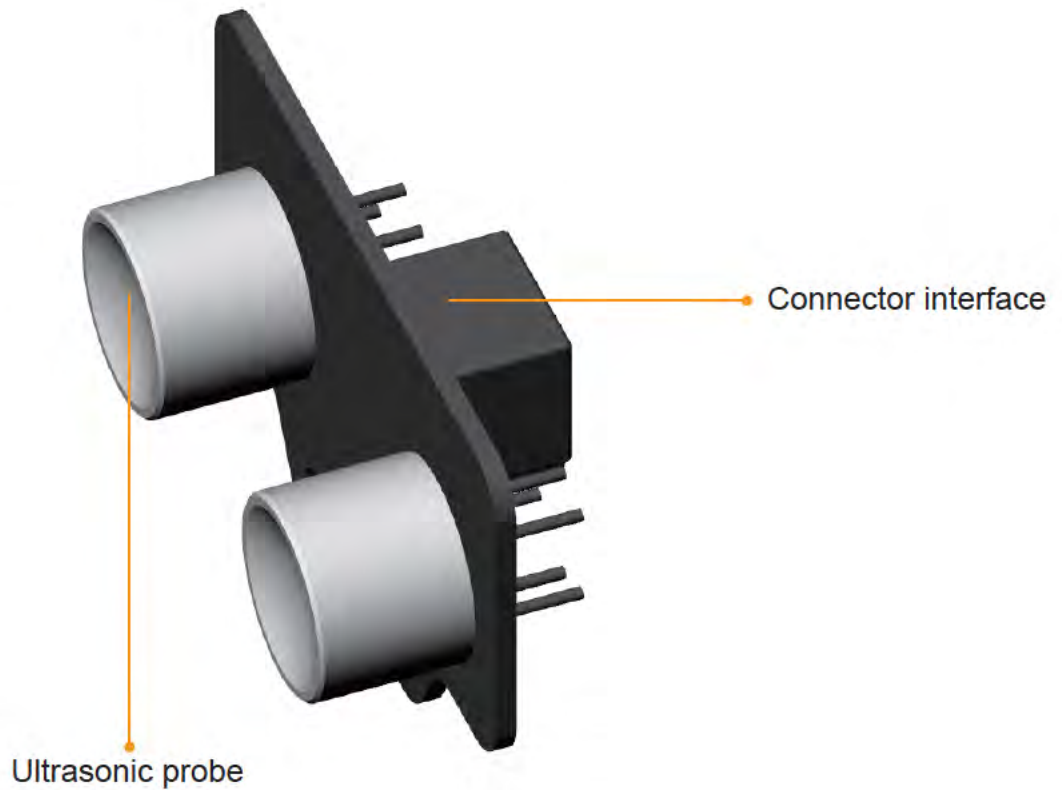
Tank is one of the most effective weapons on modern land battlefield. It is a tracked armored combat vehicle that can shoot directly and go off-road. It is mainly composed of weapon systems, targeting systems, power systems, communication systems and armored body.

The great destructive power of the tank not only brings victory in the war, but also brings destruction to the world. The Earth is now crumbling, and many many people lost their homes to wars. It is hoped that powerful weapons are used to protect homes but not to destroy them.





# Learn about the electronic parts



An ultrasonic sensor detects the obstacle in front and then feeds back the detected information to the motherboard, so that the motherboard can send other operational commands. Ultrasonic sensors are widely used in our life, such as liquid level detection, robot collision avoidance and burglar alarms. They make our work and life more convenient and faster.

An ultrasonic sensor works in the following way: Its ultrasonic probe first transmits the ultrasonic wave, the ultrasonic wave gets reflected when it reaches an obstacle, and then the probe receives the reflection information and feeds back the information to the motherboard.

# Learn about the programs



## Set avoiding obstacles

👉 Function: Avoid obstacles.

👉 How: Put the "ultrasonic sensor value" into the logic calculation module and set the value. Then put the entire statement block into the conditional statement block. (Valid range for ultrasonic sensor value: 50-1500)

The screenshot shows a programming interface titled "My application". On the left is a sidebar with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains a script starting with "when clicked", followed by a "forever" loop. Inside the loop is an "if" block: "if read ultrasonic sensor port 1 < 500 then". The "then" block contains three steps: "Motor rotation left: -50 right: 50", "wait 0.5 secs", and "Stop exercising".



# Learn about the programs



## Set moving forward

- 📁 Function: Make the ultrasonic warrior move forward.
- 📁 How: Set the left and right motor speed to the same value between 50 and 100.

The screenshot shows the LEGO Mindstorms software interface for a program titled "My application". The interface includes a left sidebar with category buttons: Start (yellow), Motion (blue), Light (purple), Sound (pink), Control (orange), Operator (green), Sensing (light blue), and Variable (red). The main workspace contains a sequence of blocks: a "Motor rotation left: 0 right: 0" block, a "run forward at speed 0" block, a "set motor M1 forward at speed 0" block, a "set port 1 steering engine M1 corner 1" block, a "set port port 1 external motor speed 0" block, and a "Stop exercising" block. A preview window on the right shows the robot with "Motor rotation left: 50 right: 50".



# Try it yourself



Try setting it up and see what happens to your Q-scout!

```
when clicked
  forever
    Motor rotation left: 50 right: 50
    if read ultrasonic sensor port 1 < 500 then
      Motor rotation left: -50 right: -50
      wait 2 secs
      Motor rotation left: 50 right: -50
      wait 0.5 secs
```

The screenshot shows a block editor interface for an application named "My application". On the left, there is a sidebar with category buttons: Start (yellow), Motion (blue), Light (purple), Sound (purple), Control (orange), Operator (green), Sensing (light blue), and Variable (orange). The main workspace contains a script starting with a "when clicked" block, followed by a "forever" loop. Inside the loop, the first block is "Motor rotation left: 50 right: 50". This is followed by an "if" block: "if read ultrasonic sensor port 1 < 500 then". Inside the "if" block, there are three blocks: "Motor rotation left: -50 right: -50", "wait 2 secs", and "Motor rotation left: 50 right: -50". The "if" block is followed by a "wait 0.5 secs" block. The "forever" loop ends with a circular arrow icon. On the right side of the workspace, there are three circular icons: a magnifying glass, a speech bubble, and an equals sign.



# What did you learn?



Can you turn your Q-scout into an ultrasonic warrior?

Have you thought of other ways to use the ultrasonic sensor?







Complete the evaluation



# Great Doorman



In our life, we usually see "stay clear" signs that warn people who are near dangerous areas. At home, we often hear watchdogs yell when strangers are approaching. Actually, in addition to being our good friend, Q-scout is also a great guard. Today, let's see how Q-scout can become a guard.



# Stories in life



Dogs have become our closet companions in our daily life. In many people's minds, dogs are their very important partners. One of the reasons is that dogs are very loyal. Whether it's a pet dog, a hound or a Chinese rural dog, it always faithfully obeys the master's orders and never leave them.

Once there was an American pit bull named Chief that dared to fight against a cobra inside the house to protect its master. Although it eventually succeeded in killing the snake, it died of the snake bite. In its last minutes, it still remembered to shake its tail to its master.

Not only dogs, but many other animals in the world are kind, and we hope that they are tenderly treated.





# Learn about the programs



## Set lighting up when something gets close

- Function: Set the value of the ultrasonic sensor as a condition when Q-scout lights up when something gets close to it.
- How: Set the value of the ultrasonic sensor to less than 1000, so the indicator will be turned on if the ultrasonic sensor detects that something is getting close to it within 1 m.

```
when clicked
  forever
    if read ultrasonic sensor port 2 < 1000 then
      set # double light in LED panel to color red
      wait 1 secs
      set # double light in LED panel to color yellow
      wait 1 secs
      set # double light in LED panel to color green
      wait 1 secs
    else
      set # double light in LED panel to color turn off
```

The screenshot shows the Scratch programming environment. The title bar reads "My application". On the left, there is a sidebar with category buttons: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains a script starting with a "when clicked" block, followed by a "forever" loop. Inside the loop, there is an "if" block with the condition "read ultrasonic sensor port 2 < 1000". If true, the script sets the LED panel color to red, waits 1 second, sets it to yellow, waits 1 second, and sets it to green, with 1-second waits between each change. If false, it sets the LED panel color to "turn off".

# Learn about the programs



## Set sounding when something gets close

- 📌 Function: Set the value of the ultrasonic sensor as a condition when Q-scout makes a sound when something gets close to it.
- 📌 How: Set the value of the ultrasonic sensor to less than 1000, so a sound will be made if the ultrasonic sensor detects that something is getting close to it within 1 m.

The screenshot shows the Scratch programming interface. The title bar reads "My application". On the left, there is a sidebar with category buttons: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains a script starting with a "when clicked" event block. This is followed by a "forever" loop block. Inside the loop, there is an "if" block with the condition "read ultrasonic sensor port 1 < 1000". The "then" block of the if statement contains two blocks: "Play note on B5 beat Half" and "wait 0.5 secs".



# Learn about the programs



Now let's try to transform Q-scout into a master scout!

The screenshot shows a programming interface titled "My application". On the left is a palette with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains the following code blocks:

```
when clicked
  forever
    if read ultrasonic sensor port 1 < 1000 then
      set # double light in LED panel to color red
      Play note on B8 beat Half
      wait 0.5 secs
      set # double light in LED panel to color green
      Play note on C8 beat Half
      wait 0.5 secs
    else
      set # double light in LED panel to color turn off
```





# What did you learn?



Do you understand how an ultrasonic sensor works?  
Think about what else it can do!





Complete the evaluation



# Treasure Hunt



It's believed that everyone has a crazy idea to hunt mysterious treasure that no one ever knows. Most people have also played treasure hunt games. In fact, our Q-scout is also a "master treasure hunter"! Let's use Q-scout to play treasure hunt games today!







When speaking of treasure, people tend to think of those pirates who look for treasures in the sea and their pirate ships with skull marks. With the development of science and technology, our ships are now made of steel instead of wood. Steel is much heavier than water, and there are so many goods on board. How can the ship float in the water? An important physical law is applied here: "The buoyancy of an object in the water is equal to the gravity of water displaced by the object". This law of object floating or sinking changed the history of mankind's use of wood to build ships.



# Learn about the programs



## Set up a stop-for-treasure program

- Function: Set the value of the line tracking sensor as a condition when Q-scout finds treasure and stop.
- How: Set the value of the line tracking sensor to, and set the motor speed for both the left and right wheels to 0 when a black object is detected below the sensor.

The screenshot shows a programming interface titled "My application". On the left, there is a sidebar with category buttons: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. The main workspace contains a script starting with a "when clicked" event block, followed by a "forever" loop. Inside the loop, there is an "if" block with the condition "read line patrol sensor port 1 = 0". If true, the script executes "Stop exercising". If false, it executes "Motor rotation left: 50 right: 50".





# Learn about the programs



## Set up a treasure hunting program

- Function: Set the motor speed to have Q-scout go on treasure hunting and avoid any obstacle in its way.
- How: Set the value of the ultrasonic sensor to 50, and set the motor speed to make a turn to avoid the obstacle when the ultrasonic sensor detects an obstacle. Plus, set the motor speed to have Q-scout travel to hunt treasure.

The screenshot shows the Scratch programming environment with a script titled "My application". The script is as follows:

```
when clicked
  forever
    if read ultrasonic sensor port 2 < 100 then
      Motor rotation left: -50 right: 50
      wait 0.5 secs
    else
      Motor rotation left: 50 right: 50
```

The interface includes a left sidebar with categories: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. On the right, there are zoom and search icons.





# Try it yourself



Now let's try to transform Q-scout into a master treasure hunter!

The screenshot shows the Scratch programming environment with a script titled "My application". The script is as follows:

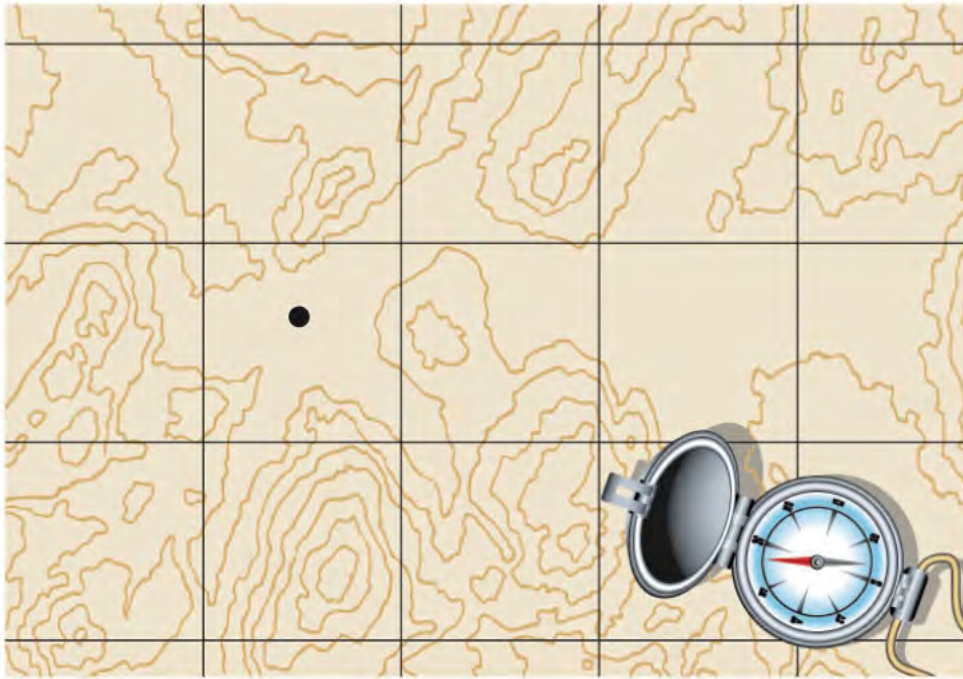
```
when clicked
  forever loop
    Motor rotation left: 50 right: 50
    if read line patrol sensor port 1 = 0 then
      Stop exercising
    if read ultrasonic sensor port 2 < 500 then
      Motor rotation left: -50 right: 50
      wait 0.5 secs
```

The interface includes a left sidebar with category buttons: Start, Motion, Light, Sound, Control, Operator, Sensing, and Variable. On the right, there are control buttons for adding (+), zooming (magnifying glass), and deleting (trash can).

# Let's go on treasure hunt



Come to see who is first to find the treasure!



<Map for reference only>

# What did you learn?



Do you know how to use the ultrasonic sensor together with the line tracking sensor? Try it yourself to see if you have any different ideas!

