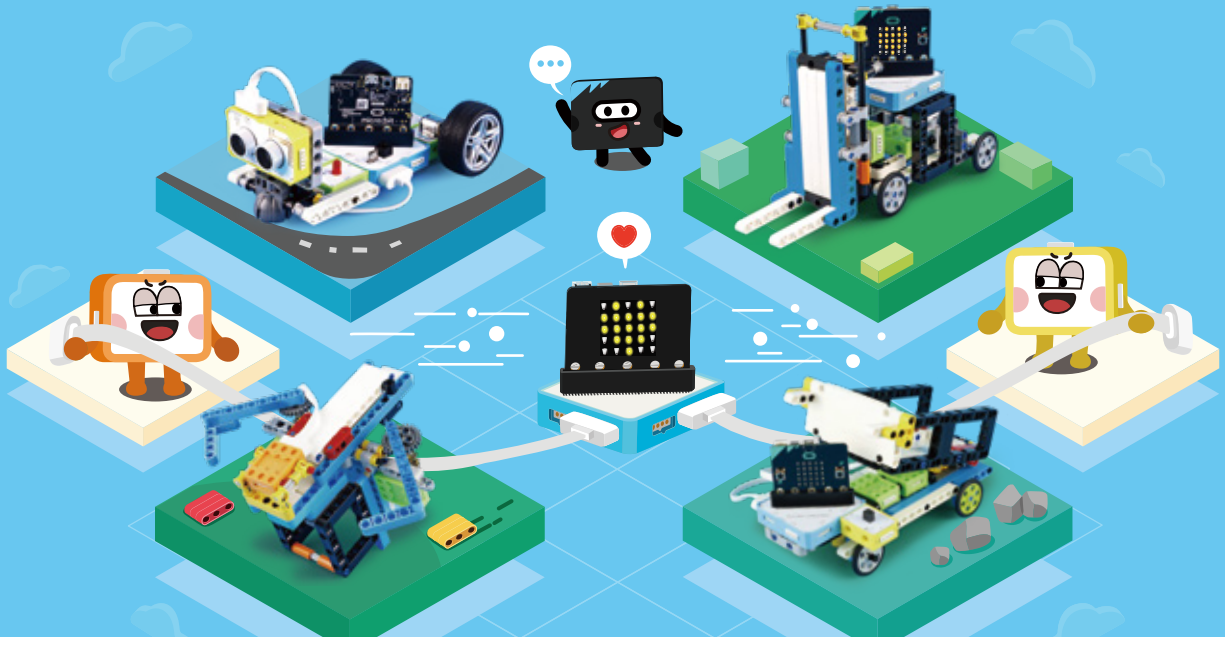
Crowbits
by Elecrow

Inventor Kit

Make Your Own Invention Trip by Coding Instantly



USER MANUAL V1.1

www.elecrow.com

Directory

About Crowbits

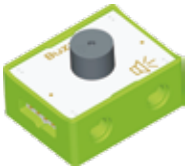
Crowbits is a STEAM educational equipment specially designed for young technology enthusiasts. It is a programmable magnetic electronic module and compatible with Lego. Standard Lego holes are designed on the bottom and sides of the module, which can be perfectly connected with Lego. Modules can realize programming-free and programming functions at the same time. Equipped with three mainboard console and hundreds of electronic modules, it will greatly inspire kids' creative ability. The modules are perfectly packaged and connected by magnet, so that young kids can quickly get started and enjoy much fun with a simple plug.

"Inventor Kit" is the primary programming kit of Crowbits series. It uses Micro:bit as the mainboard console, and combines with electronic modules as well as Letscode, a visual graphics programming software. Through simple drag-and-drop programming, kids can create interesting and creative projects, which greatly lowers the threshold of artificial intelligence learning.

"Inventor Kit" encourages kids to create robots actively and design smart programs. There is also code programming such as Arduino and Python for you to explore. In this way, kids will keep their interest in learning and find the joy of science and technology, and code programming such as Arduino and Python is waiting for you to unlock!

• Modules List of Inventor Kit

DC Motor x2



Buzzer x1

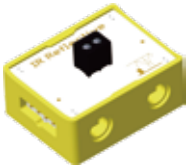
LED x1

Color Sensor x1

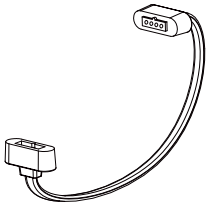
Gesture Sensor x1

Micro:bit Compatible x1

Ultrasonic Ranging Sensor x1



IR Reflective Sensor x2

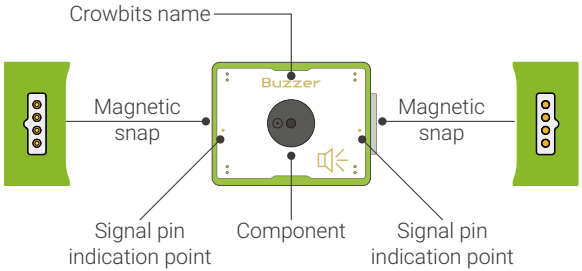


Magnetic Cable x4

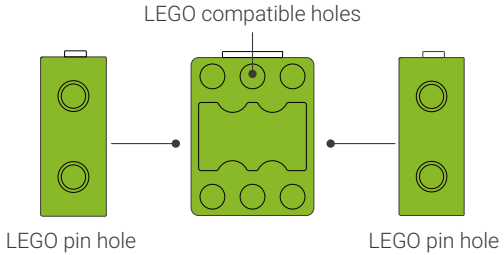
Get to Know Crowbits Modules

Structure:

Front:



Back:



Crowbits name: Crowbits consists many types of modules, so we marked the name for you to recognize easily.

Component: The main component of Crowbits is placed there.

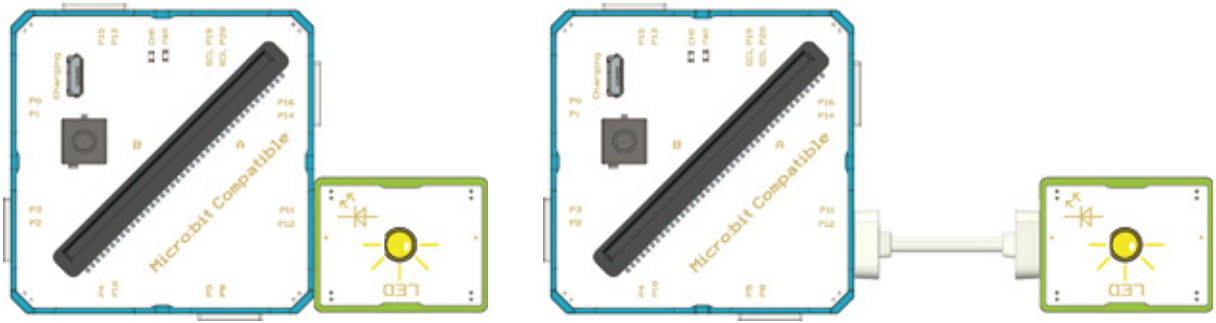
Magnetic snap: It's a magical magnetic pogo-pin, and the magnetic snap allows you to connect Crowbits together with magnet.

Signal pin indication point: This point represents the position of the signal input/output pins of the module. When connected to the main console or other modules, only the pins at this point can control the module. The main console uses the pin number to label the corresponding input/output pins.

A number of Lego holes are reserved on the back and side of Crowbits electronic modules, which are perfectly compatible with Lego rods or pins, and the connection is extremely convenient.

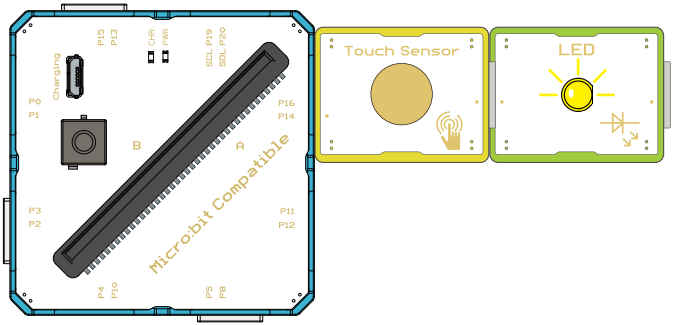
• Connection Method

The modules can be directly connected by magnet or connected by magnetic cables.

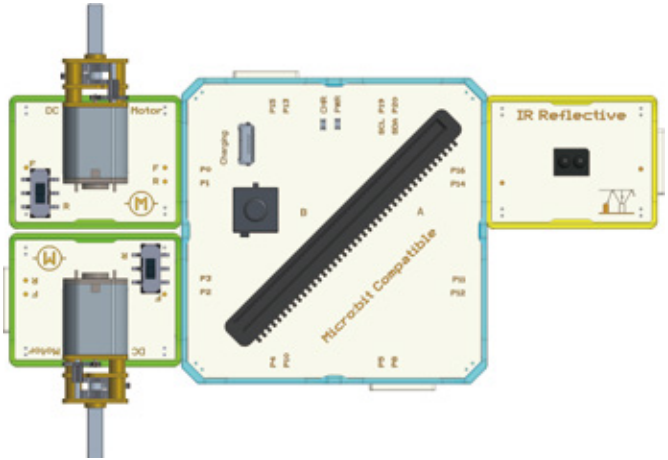


• Connection Rules

The programming-free mode of the modules must include the power supply (the mainboard console expansion board can also be used as a power supply), input module and output module, and the output module must be connected to the right side of the input module to ensure that the output module is controlled by the input module.

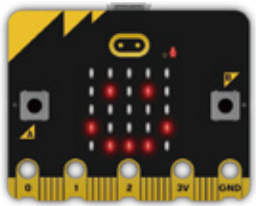


The programming mode needs to download the program to the Micro:bit mainboard console (you need to insert the micro:bit mainboard into the expansion module when using it). The mainboard console can control the input/output module through the signal pins, which can be connected at will, but it cannot be cross-connected.



• Micro:bit

Micro:bit is a microcomputer for programming education of teenagers launched by the British BBC company. The motherboard integrates an accelerometer, a compass sensor, two programmable buttons, 25 monochrome LEDs, Bluetooth and other commonly used sensor devices. It's powered by a micro USB port and can be attached to an external battery box. There are multiple ring-hole connectors at the bottom that can be used to control external devices.

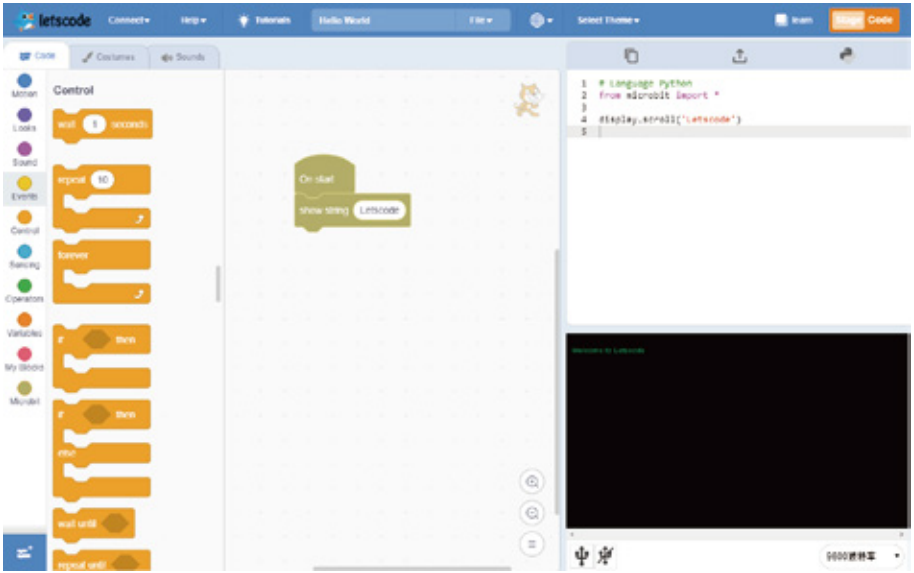


The Crowbits-micro:bit-compatible module is an expansion board that adapted to micro:bit, which leads out micro:bit pins to be used with the crowbits module. Insert the micro:bit into the expansion board as the picture shown below, and then the connected crowbits modules can be controlled through the pins.

Turn on the switch when using.

Letscode Software Introduction

Letscode is a graphical programming software which created mainly for the global needs of science and technology innovation education. With letscode, you can program by only dragging the building blocks with the mouse. It can help you learn the program of game design and robot control easily. Here are some highlighted functions of Letscode.

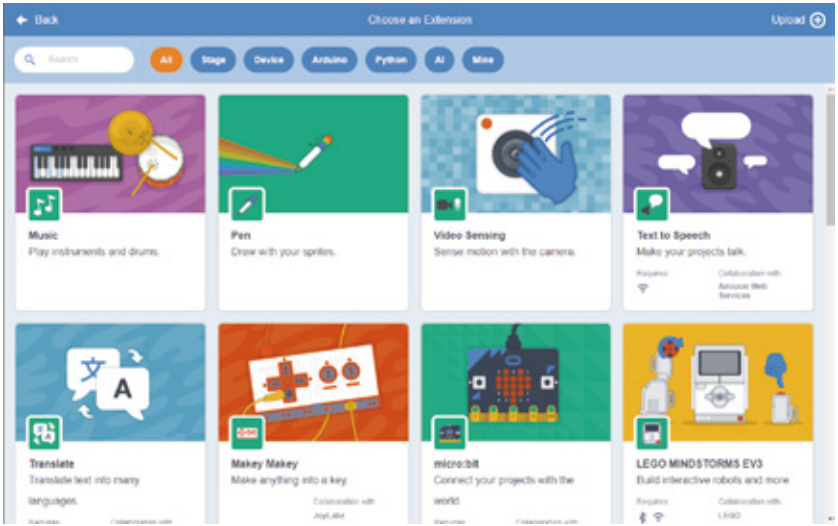


1. Well-compatible with various hardware devices like WeDo, LEGO, Arduino, Micro:bit, ESP32, DevkitC and so on.

2. Letscode can program and control hundreds of hardware modules like sensors, actuators, displays, communication modules and other functional modules.

3. Letscode also support AI and IoT learning. With open-source and abundant user libraries, users also can create extended libraries for themselves.

4. Except for the graphical programming, you can also change over to Python/Arduino C to program in real-time.



- **Here We Will Mainly Introduce The Use of Micro:bit Extension Modules.**

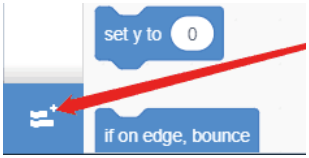
- **The Way to Get The Letscode Software:**

Logging in to official website: **forum.elecrow.com**.
Then search in the download area to download the Letscode software and double-click it to install.

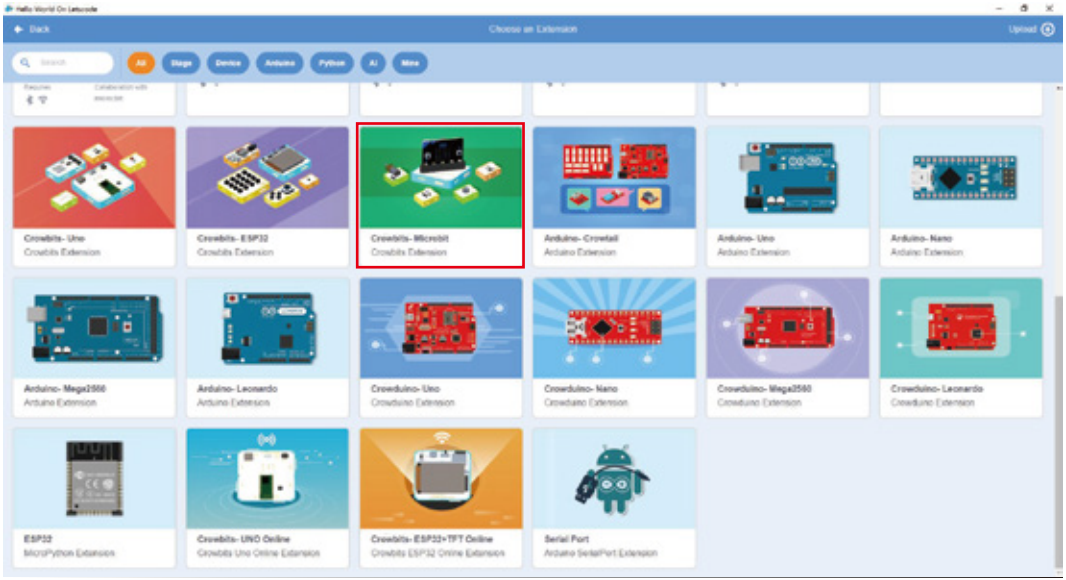
1. Opening the Letscode and Connecting the Devices

1. Double-clicking Letscode to open it on computer desktop.

2. Clicking “Adding Extension”.

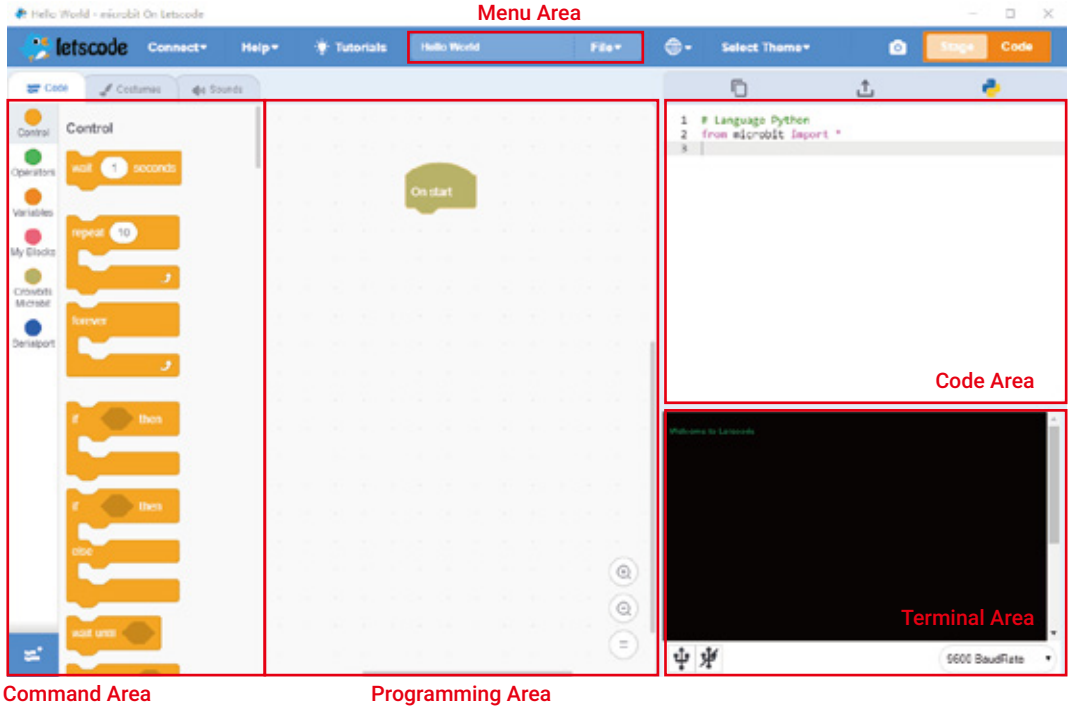


3. Dropping down the right scroll bar to find Crowbits-Microbit and click it.



Then Micro:bit block showing in the left sidebar “Code”, which means we have imported the Micro:bit module successfully.

And there are five areas for code mode: Command Area, Programming Area, Code Area, Terminal Area and Menu Area.



Command Area: Many code blocks offered with different colors and shapes for different functions.

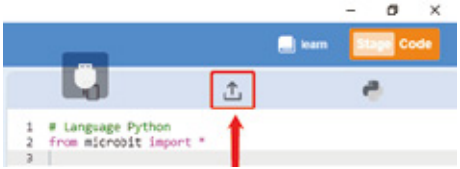
Programming Area: Dragging code blocks to programming area. And then matching them logically to implement the program.

Code Area: Converting the code block programs into Python code in real time.

Terminal Area: Shows the compilation and download of the program, as well as the input and output of data.

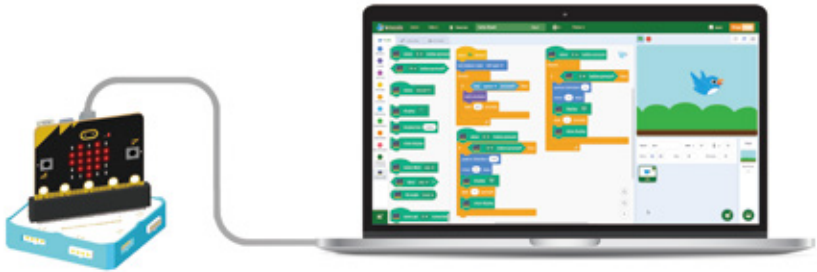
Menu area: The basic operation area of the software, open the file, select the language, etc.

Program Uploading: Clicking the upward arrow button to upload your program to Micro:bit board.

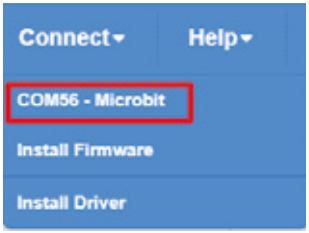


2. Connecting the Devices

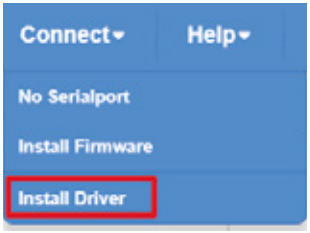
1. Connecting the micro:bit board with your computer by micro-usb cable.



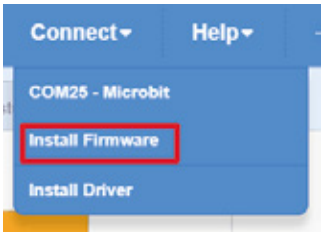
2. Clicking button “Connect” with the mouse, then you will see COM in the drop-down list. Here showing COM56, which may change according to the different computer you connected. Then clicking “COM56” button, if “√” showing, that means connect succeeded.



3. If no serialport number is displayed, click Install Driver.

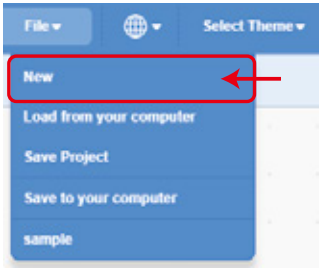


If you are downloading mincro:bit for the first time using LetsCode, install the firmware first.

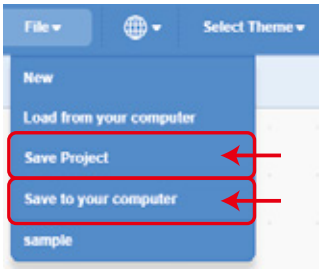


3. Instruction of Program Files

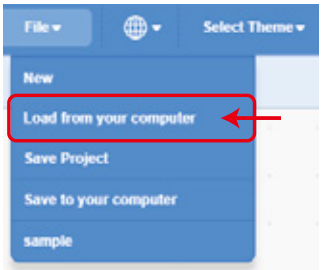
1. New Files: Clicking button “New” in the drop-down list of “File” to create new program files.



2. Files Saving: For the first time saving your files, you can click button “Save Project” then choose save path and give it a name to save it. Clicking “Save Project” again, the files will be updating saved based on the previous files. If another file version needed, please click “Save to your computer” button and set the save path and file name again to store it.



3. File Opening: When you want to open existing Scratch files, please click “Load from your computer” button and find the file and click it.



Project 1 Horizontal Bar

1. Learning Goals

1. Learning about the sports meeting program: horizontal bar gymnastics.
2. Learning how DC motor and IR Reflective sensor work.
3. Mastering the programming and building of horizontal bar robot.

2. Application

Horizontal bar is a challenging but wonderful competitive sports project. In our daily life, we also can see it around us as a normal fitness equipment which can strengthen your arms and improve your body's coordinate ability.

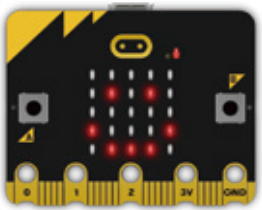
Now we are going to use the bricks and crowbits modules to build a horizontal bar structure and start programming to control the little man on it to do different kinds of gymnastic movements.

3. Supplies List

• **Electronic Supplies:**

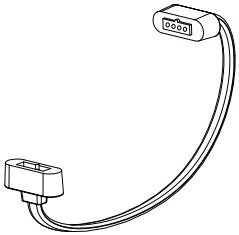
IR Reflective Sensor x1

DC Motor x1



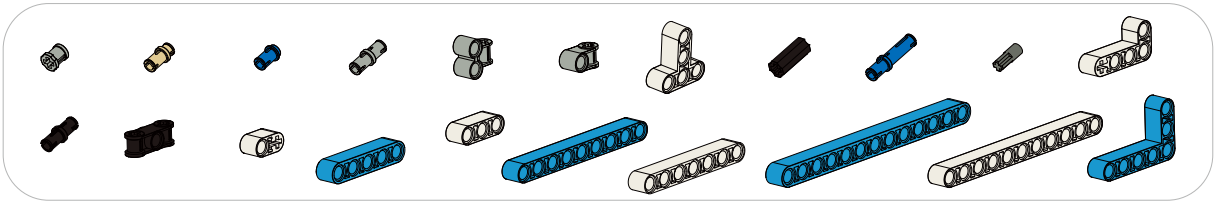
Micro:bit x1

Micro:bit Compatible x1



Magnetic Cable x2

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



4. Knowledge Analysis

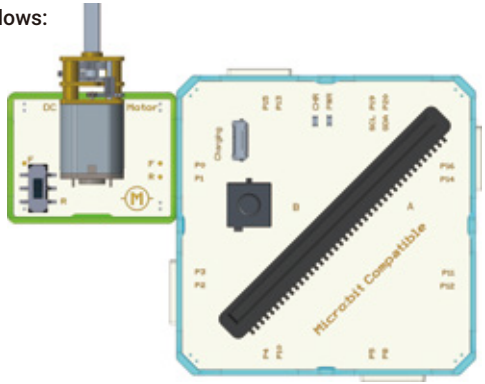
• DC Motor

1. DC Motor Module is a digital output module. It can transform electric energy to be mechanical energy to drive loads. When there is a signal input from the left side, we can toggle switch on the module to control the clockwise&anticlockwise rotation of the motor. And we can choose direction of rotation according to the actual situation. When the corresponding two signal ports of motor module and main control board connected, we can change the signal of the port to control the motor rotate clockwise or anticlockwise by programming. At this moment, the switch should be toggled to be 'F'.

Due to different batches of the motor, the rotation direction of the motor may be inconsistent, so when using the pin to control the rotation direction of the motor, it is necessary to control the high and low level of the pin according to the actual situation.

2. Connection

As follows:



3. Program-Driven

The work of the motor is controlled by a high and low level of the two input ports' signals.

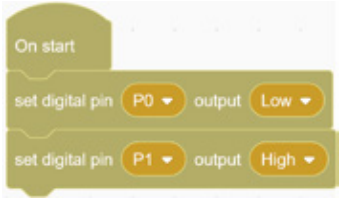
Here show how the high and low level controls the rotation of the motor:

Port P0	Port P1	Motor Rotation
HIGH	LOW	Anticlockwise Rotation
LOW	HIGH	Clockwise Rotation
LOW	LOW	Stop Working

If you want to control motor to rotation, you can program according to following steps:

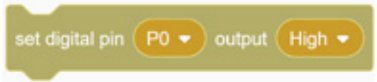
First of all, finding block 

from command area.

Block	Example
 Explanation: This block is for starting the event. When the device starts, the program runs	 When the device is started, the motor connected to P0 and P1 will start to rotate

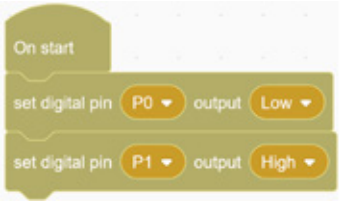
Secondly, finding building block 

from command area.

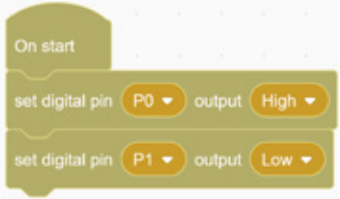
Block	Example
 Explanation: Setting high or low-level for P0	 Setting low level for P1 port  Setting high level for P0 port

Thirdly, building block.

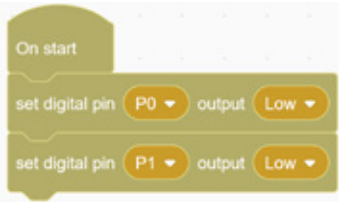
1. If you want to control the motor rotate clockwise, input low level to P0 and high level to P1.



2. If you want to control the motor rotate anticlockwise, input high level to P0 and low level to P1.

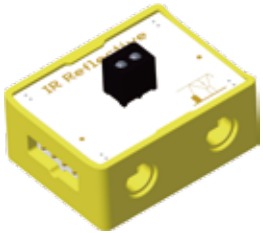


3. If you want to stop the motor, input low level to both P0 and P1.



• IR Reflective Sensor

IR Reflective module is a digital module. It just like your eyes which can detect the articles in right front of it and then give a reaction. IR Reflective modules normally are used in cars to track and avoid obstacles. They are consist of a infrared sending tube and a receiving tube. When infrared sending tube sends infrared ray and receives by receiving tube through reflecting which is not caused by black objects, then the receiving tube will work and output a high level signal. But when there is a black objects detected, the IR reflective will output a low signal.

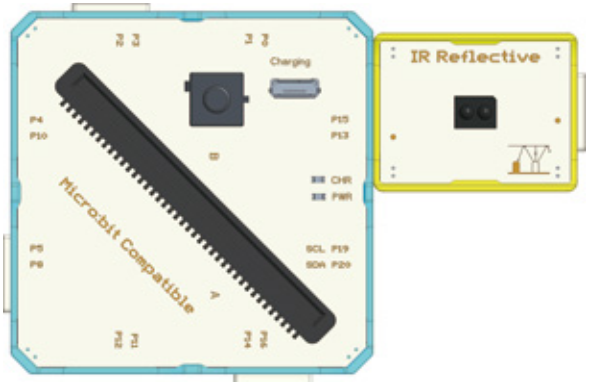


Note:

1. Available detective distance for IR Reflective is less than 30mm.

2. The reflection effect of lighter color objects is better than deeper colors'.

1. Connection



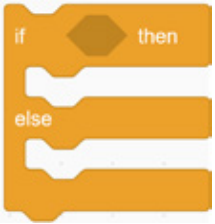
2. Program-Driven

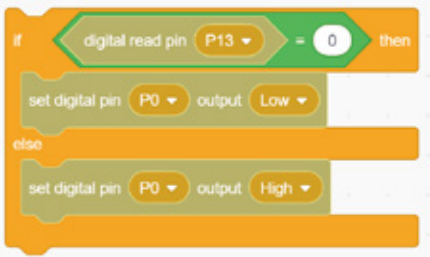
You can write the program based on the following table.

Detected object	IR Reflective Signal Level
Yes	High Level/1
No	Low Level/0

Next, we will use the following blocks

Block	Example
 Explanation: Compare block. Determine if the values on both sides are equal	 Judge if the value read from P13 port is equal to 0
 Explanation: Reading the signal level of the digital port. For example, when reading the signal of IR Reflective port, we can get high level “1” and low level “0”	

<table>
<tr>
<td> 

Explanation: This is conditional judgment which is similar as what we usually said if ...then ....else. Just like if it rains then we will take a umbrella else we will not</td>
<td> 

If the value read from P13 port is 0, then set P0 port output LOW signal, otherwise, set P0 port output HIGH signal</td>
</tr>
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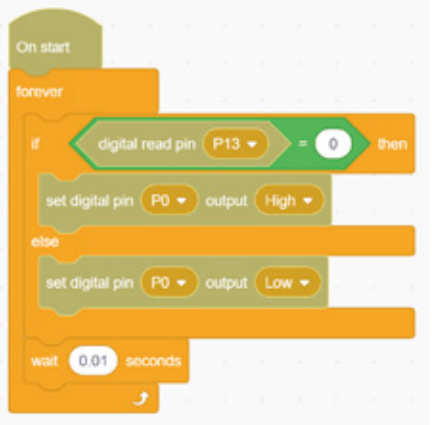
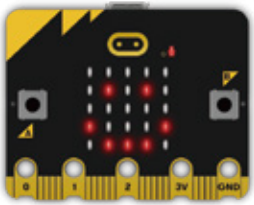
<td> 

Explanation: Repeat execution, which means doing the same thing repetitively</td>
<td> 

If the value read from P13 port is 0, then set P0 port output HIGH signal, otherwise, set P0 port output LOW signal. The judge process will be repetitively proceeded</td>
</tr>
</table>

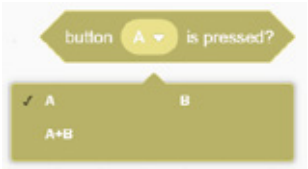
• Buttons



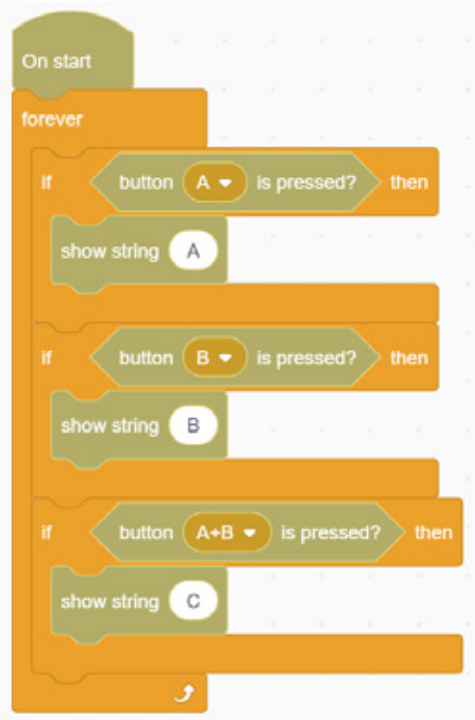
1. Here button modules mean the buttons integrated on micro:bit board, the button A and button B. There are three situations of button pressing: press button A only, press button B only, and press button A and B at the same time.

2. Program-Driven

Now we need to use following blocks.

Block	 Explanation: Checking which button is pressed.
Example	

One more example, if you want to let Micro:bit display letter A when button A is pressed, letter B when button B is pressed, and letter C when button A and button B are pressed at the same time, you can program it as follows:

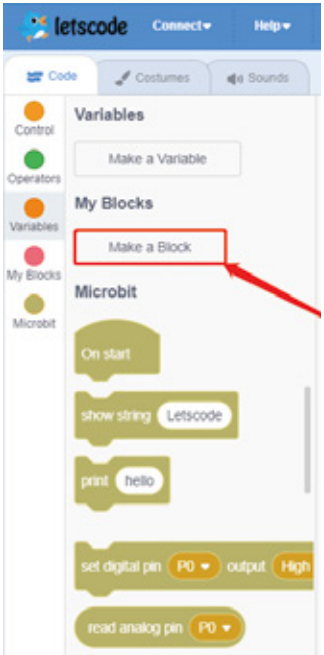


5. Custom Block

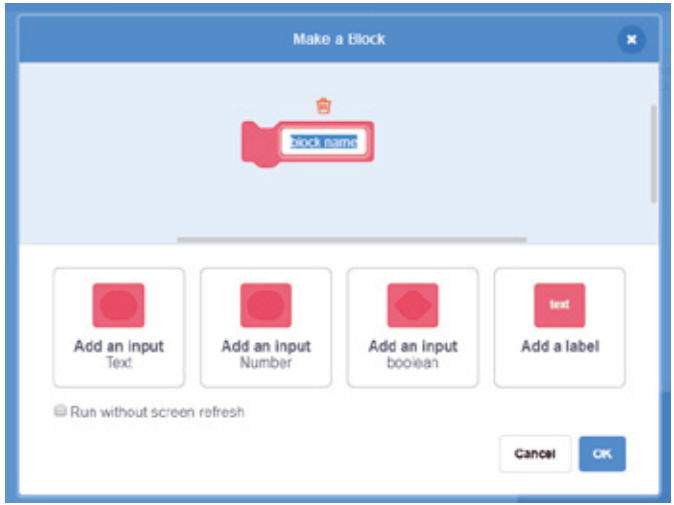
• **To make your program better organized, you can define your own custom block.**

Here is how to create a custom block and how to use it:

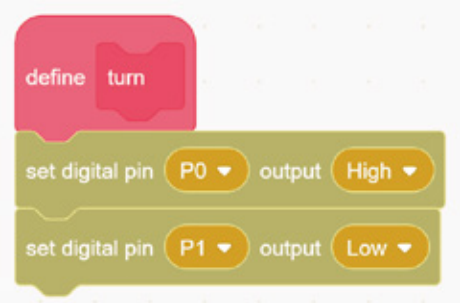
Step 1: Clicking the button of "Make a Block";



Step 2: Naming the block (function name);



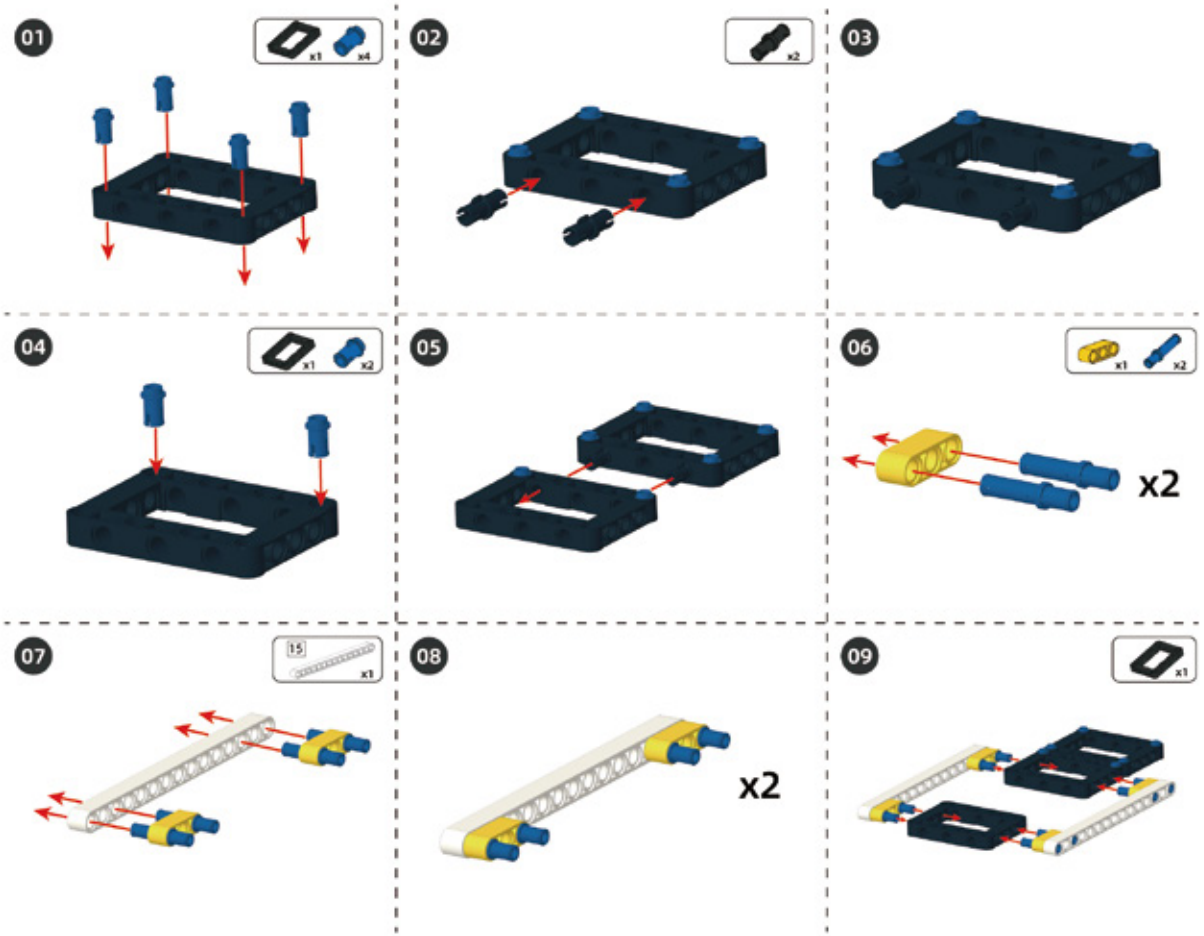
Step 3: Defining the function of custom block;



Step 4: Calling the custom block;

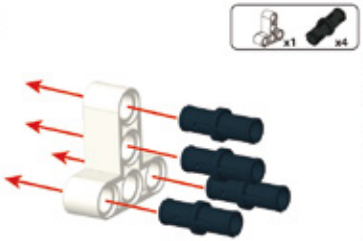
6. Model Building

- **Structure Building**

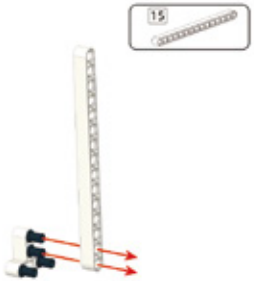

01
x1
x4
02
x2
03
04
x1
x2
05
06
x1
x2
x2
07
15
x1
08
x2
09
x1

10

11

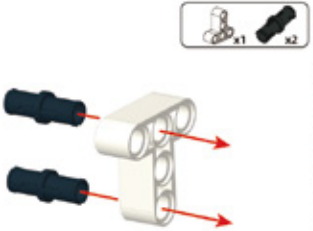


12



13

14

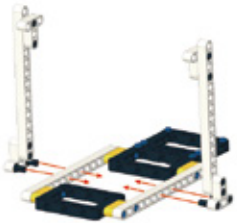


15

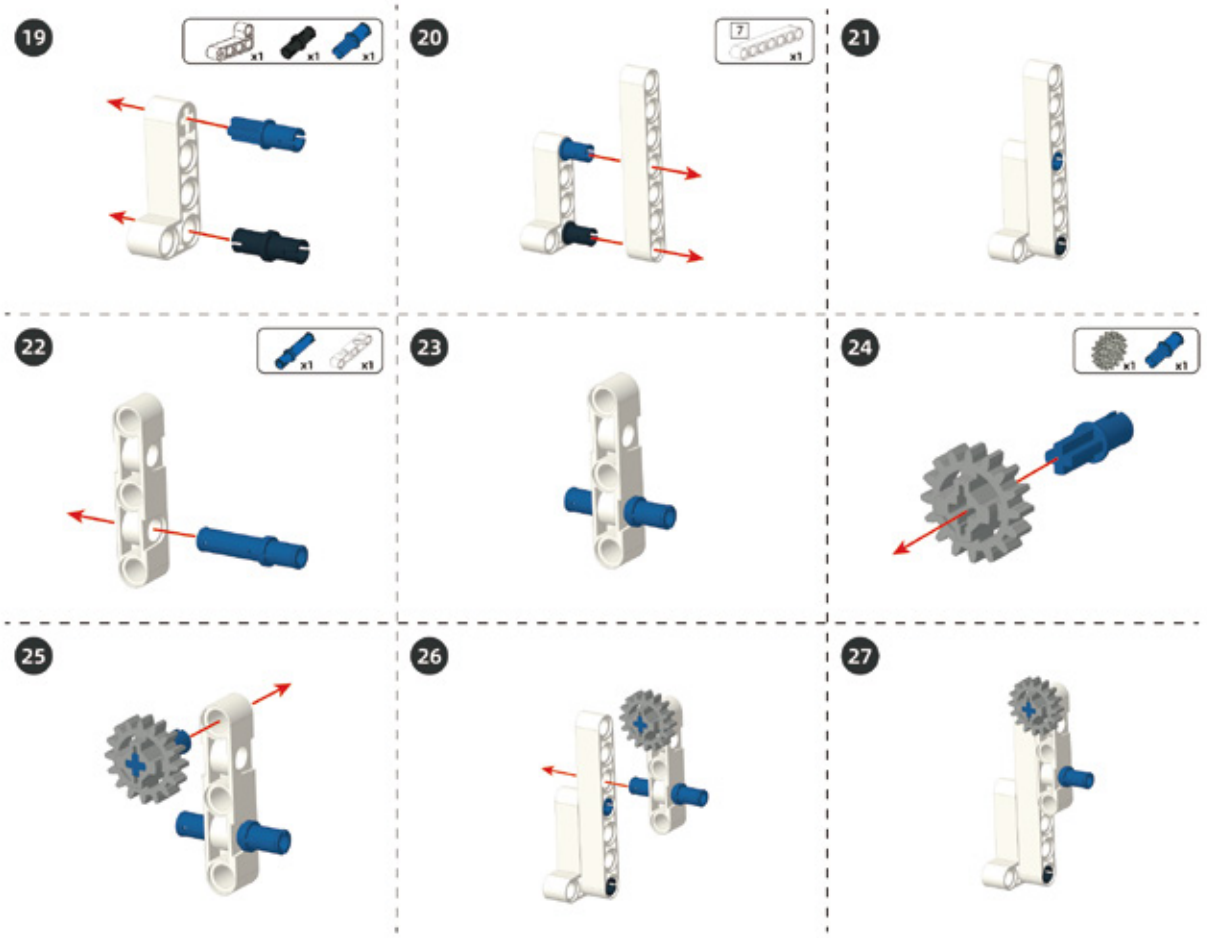
16

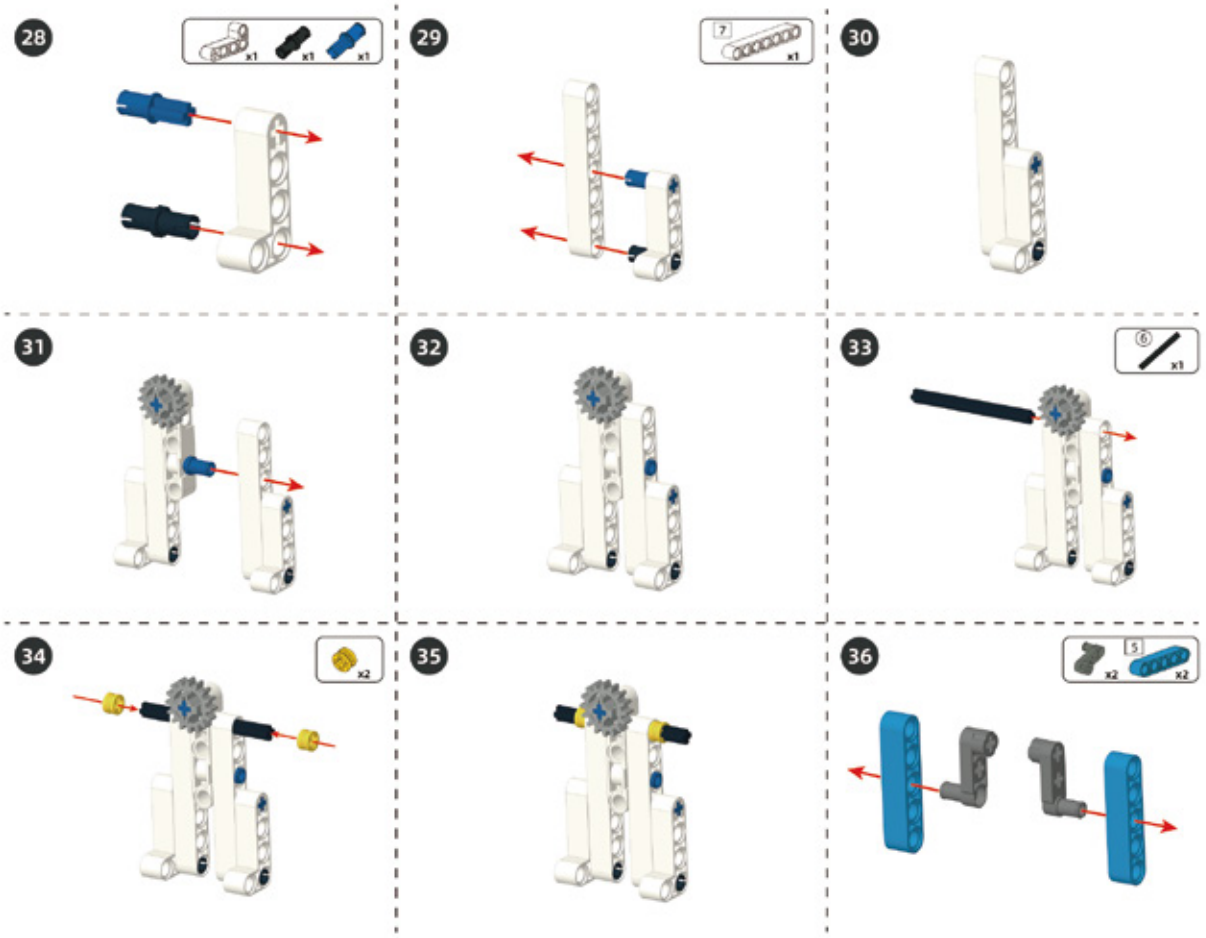
x2

17



18


19
x1
x1
x1
20
7
x1
21
22
x1
x1
23
24
x1
x1
25
26
27


28
x1
x1
x1
29
7
x1
30
31
32
33
6
x1
34
x2
35
36
5
x2
x2

37

38

39

40

41

42

43

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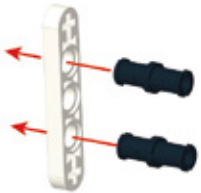
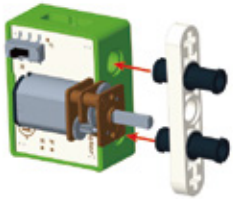
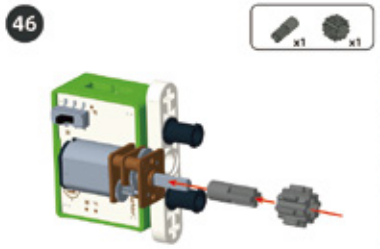


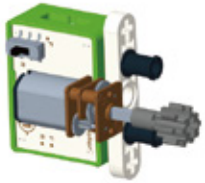
45



46



47



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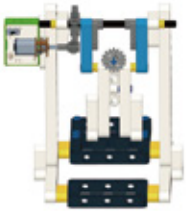

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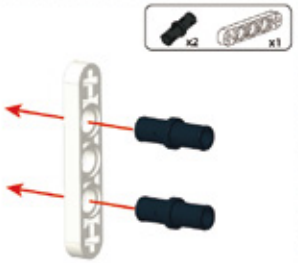
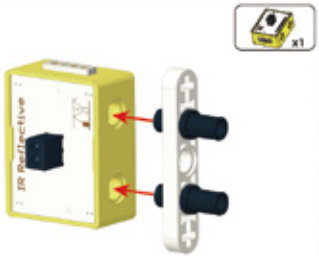
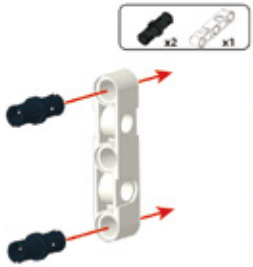


53

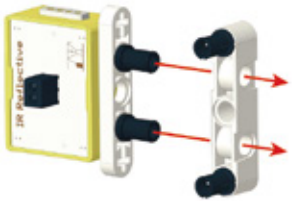


54

55



56



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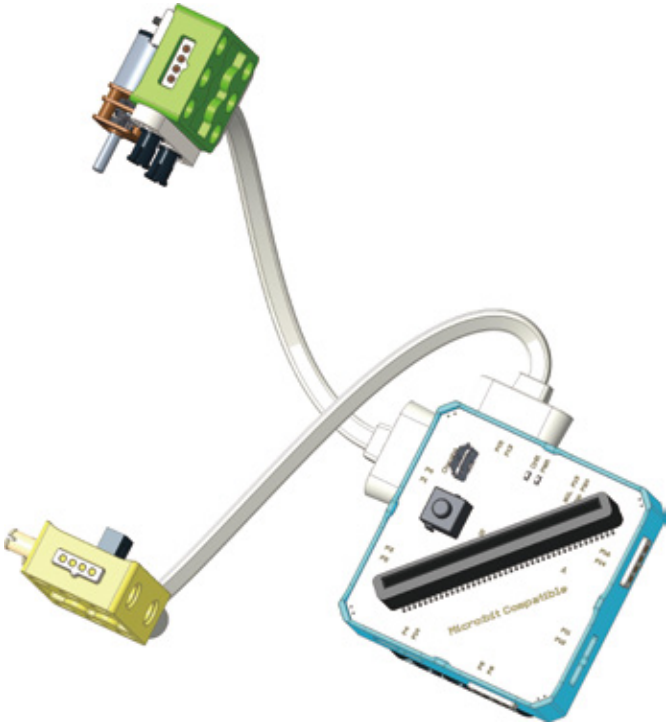
• Circuit Connection

Connect the circuit according to following diagram.

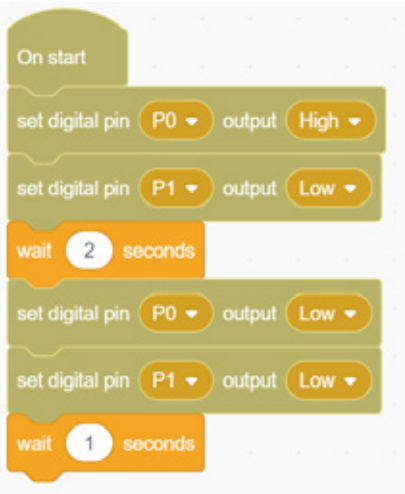


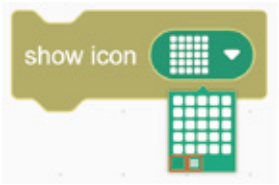
7. Task to Practice

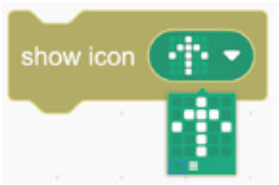
Task Goal: Controlling the little man to do different kinds of gymnastic movements through programming.

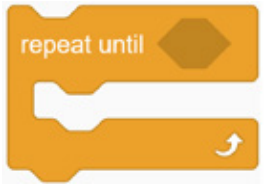
Task Analysis: There are three parts for little man to do horizontal bar movements: turn clockwise, counterclockwise and return to initial position.

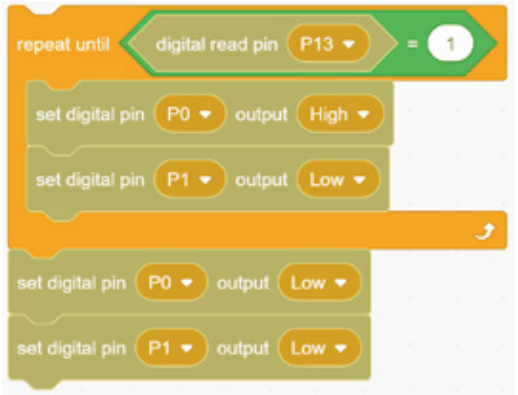
Here we will use another two building blocks.

Block	Example
 Explanation: Delay block; you can let the program stop at this block to wait for the time you want. The triggered port level will remain for a period of time	 Doing anticlockwise rotation for two seconds then stopping rotation for one second

<table>
<tr>
<td> 

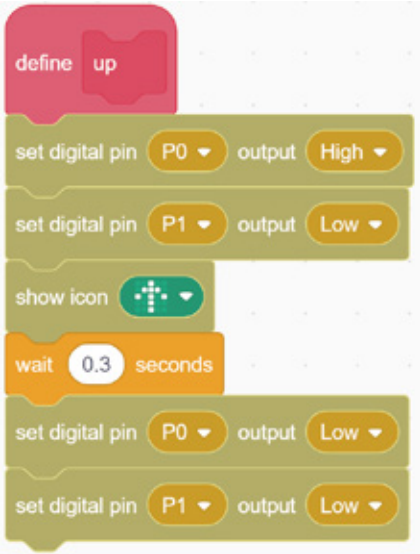
Explanation: Display icons on the LED matrix. White means light up.</td>
<td> 

First press the circled part to turn off the light, and then turn on the LED according to the desired pattern.</td>
</tr>
<tr>
<td> 

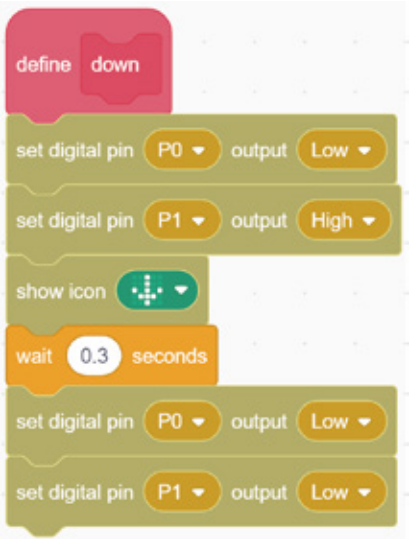
Explanation: Repeat execution until a certain condition is satisfied</td>
<td> 

Assuming that connecting the motor module to P0 and P1 ports.Then operating the program of motor repeating rotating till the P13 port level turns to be 1. Once P13 port level turns to be 1, the condition works and the loop ends and then the motor stops rotating.</td>
</tr>
</table>

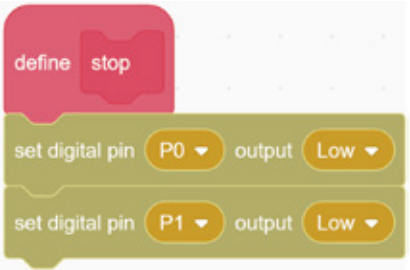
1. Little man's anticlockwise moving can ensure the motor rotating for a while then stopping or the motor will keep rotating towards one direction all the time.



2. Clockwise moving for little man;

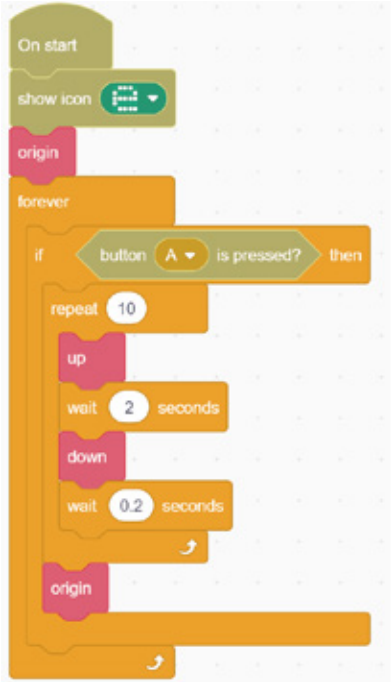


3. Stopping movement;



4. Backing to initial location; We use the IR Reflective Sensor to determine the location. When the IR Reflective sensor detected the object, it means the little man already rotated to the location of the IR Reflective sensor. And then we will adjust the location downward moderately.

5. Using different buttons to control different movements like only when pressing button A, the little man will start to move.



Above is a completed program. After downloading this horizontal bar program to main board and running it, you can watch many different movements of little man through pressing the different buttons.

For the complete program, please visit the official website to download: forum.elecrow.com.

8. Game Interactions

Invite your families and friends to experience your creation! Let's have a competition of horizontal bar! You can change the program and also its parameter according to your idea and show your creation to each other to see whose design is more interesting and creative.

9. Brainstorming

For the horizontal bar project we used a DC motor and an IR reflective sensor. Motors are often used in power transmission systems, such as cars, fans, conveyor belts, etc. IR reflective sensors are often used in intelligent devices, such as crowd monitoring devices. You can try designing an automatic mixer or a revolving door using these two electronic modules.

Project 2 Ultrasonic Guitar

1. Learning Goals

1. Know the practical application of ultrasound.
2. Learn how to use the ultrasonic sensor and buzzer module.
3. Complete the build and programming of the electric guitar.

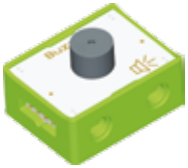
2. Application

Ultrasound is a sound wave with a frequency over 20000Hz. It has good direction, strong reflectivity, and is easy to obtain more concentrated sound energy. It travels farther in water than in air. Besides, it can be used for distance measurement, speed measurement, cleaning, welding, breaking stones, sterilizing, etc. There are many applications in medicine, military, industry, and agriculture.

Guitar is a common musical instrument. Can we use the characteristics of ultrasonic ranging sensors to make an ultrasonic guitar? Of course, let's make a different guitar today.

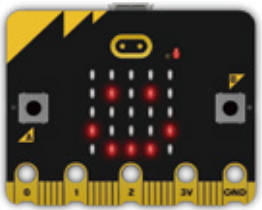
3. Supplies List

• **Electronic Supplies:**



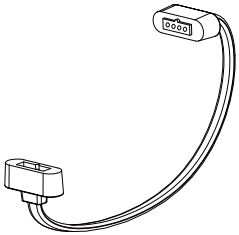
Buzzer x1

Ultrasonic Ranging Sensor x1



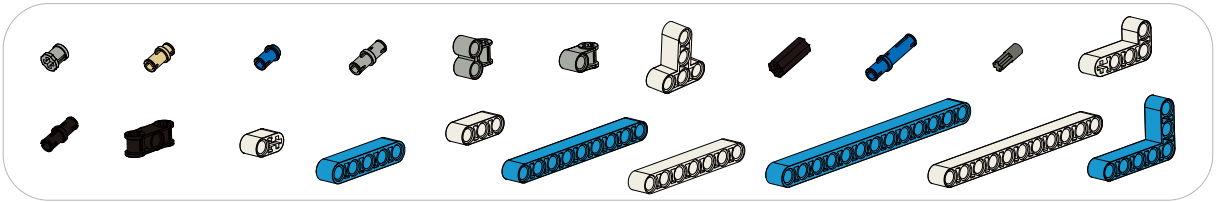
Micro:bit x1

Micro:bit Compatible x1



Magnetic Cable x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**

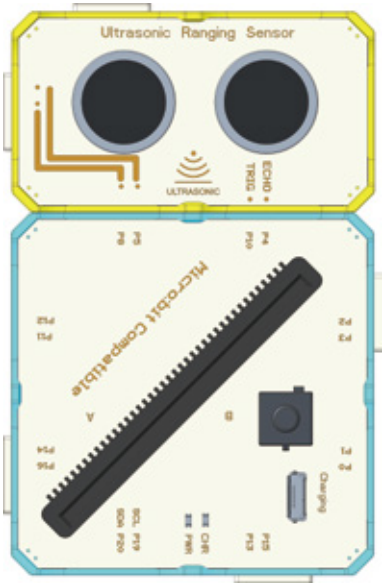


4. Knowledge Analysis

• Ultrasonic Ranging Sensor

1. Ultrasonic Ranging Sensor: It is an analog input module that can detect the distance between the module and the front object. It is known that ultrasonic wave, like sound, has a propagation speed of about 340m/s in the air at room temperature. The principle of ultrasonic ranging sensor distance measurement: At the same time as the ultrasonic wave is launched, the counter starts timing. When it encounters an obstacle in front, it will reflect back. When the ultrasonic module detects the reflected ultrasonic wave, it stops timing. At this time, the timer will get the time T required to move back and forth between the ultrasonic wave and the obstacle, and one-way time is T/2. (T: unit second s). So, using the formula of distance S=V*T, the ultrasonic ranging sensor ranging algorithm can be obtained: S=340*T/2.

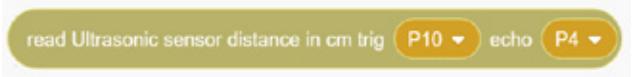
2. Circuit Connection:



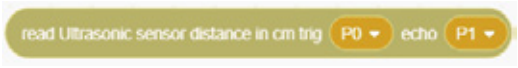
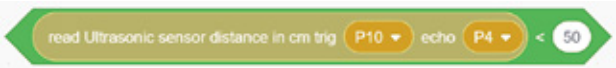
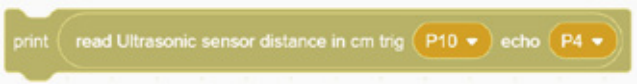
3. Program Driven

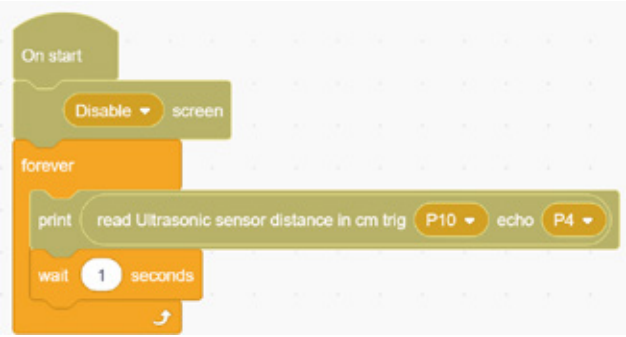
The value of distance detected by the ultrasonic ranging sensor can be displayed through the computer serial port.

Method: use 

block and 

block.

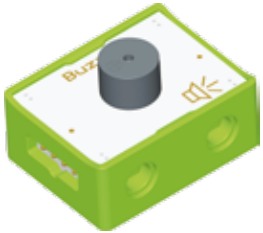
Block	Example
 Explanation: Obtain the ultrasonic ranging value	 Judge if the distance value detected by ultrasound is less than 50
 Explanation: Display the printed content on the serial monitor	 Print the distance detected by ultrasonic ranging sensor



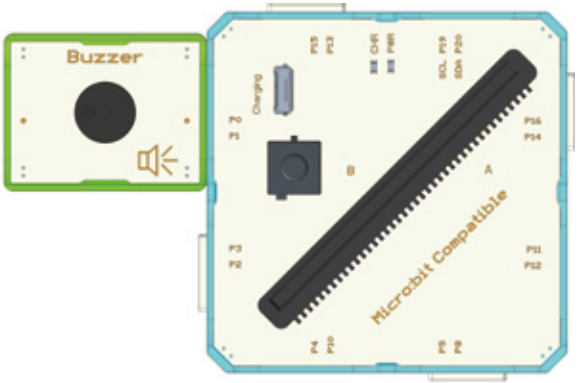
The distance will be displayed on the serial minitor

• Buzzer:

1. Buzzer: It is a digital output module. When it receives an input signal, it will emit a sound. The buzzer is mostly used for prompts or alarms. The core part of the buzzer module is an electromagnetic buzzer. The presence and level of the sound can be controlled by the input signal. When a logic-high input signal is received, due to the internal structure of the electromagnetic buzzer, if an electric current passes through, a magnetic field is generated inside the buzzer, and the vibrating diaphragm periodically vibrates and emits sound under the action of the magnetic field.



2. Circuit Connection:



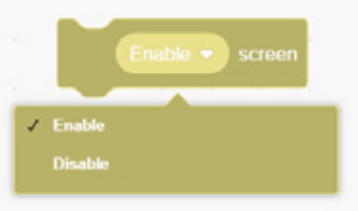
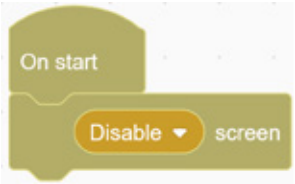
3. Program Driven:

The effect of inputting different signals to the buzzer is as follows:

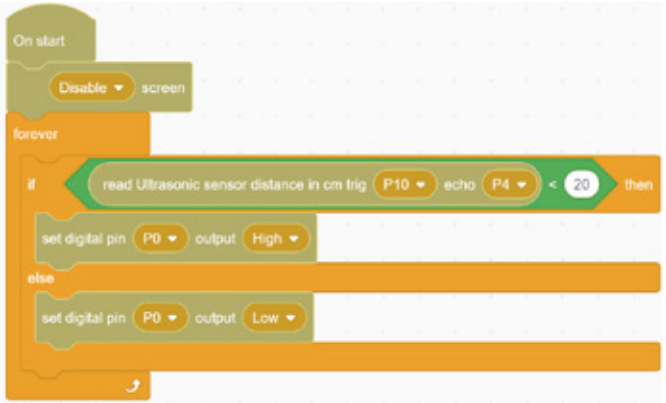
Input	Effect
Low level/0	Don't ring
High level/1	Ring

It should be noted that the dot matrix screen of the micro:bit board occupies ports P3, P4, P6, P7, P9, and P10. If these pins are used in other functions of the project, they need to be released in advance.

Use  block:

Block	Example
	
Explanation: The block has two options, one is "Enable", the other is "Disable"	Release the pins of the dot matrix screen, which means it can be redefined and used
	
Explanation: Compare blocks; determine which value is larger or smaller	Determine whether the ultrasonic ranging value is less than 20 cm

For example, we want to make the buzzer sound when the ultrasonic ranging sensor detects an object in front of it, otherwise, the buzzer will not sound, we can program it as follows:

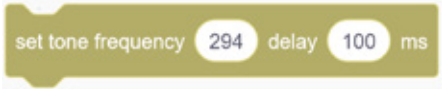


• Tone Frequency

If you want the buzzer to emit different tones, you need to input the corresponding frequency. The following is the frequency reference table corresponding to the tone.

musical alphabet	frequency	musical alphabet	frequency	musical alphabet	frequency
Bass1	261.63	Midrange1	532.25	Treble1	1046.50
Bass2	293.67	Midrange2	587.33	Treble2	1174.66
Bass3	329.63	Midrange3	659.25	Treble3	1318.51
Bass4	349.23	Midrange4	698.46	Treble4	1396.92
Bass5	391.99	Midrange5	783.99	Treble5	1567.98
Bass6	440	Midrange6	880	Treble6	1760
Bass7	493.88	Midrange7	987.76	Treble7	1975.52

For example, if you want to make a bass 2, fill in 294 in the first position and 100 in the second position. The delay time can be adjusted according to the situation. The default interface of the audio block is port P0, so if use the following block, the buzzer must be connected to port P0.



Note: When using it in letscode, we need to round to the nearest integer.

• Variable

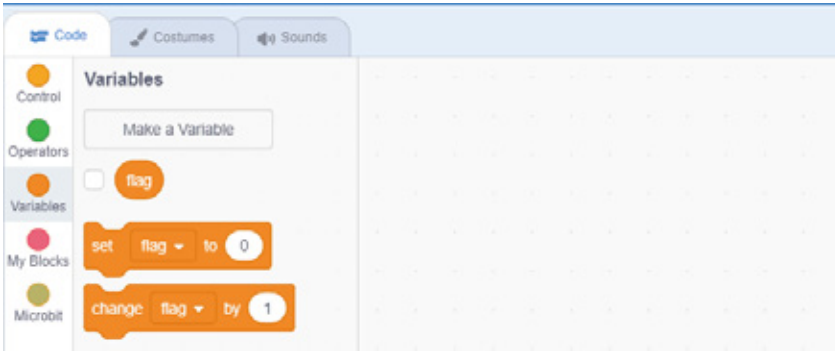
We will use variables in many programs, which will bring great advantages to our programs. Variables are similar to a box, which can hold data of different types and sizes. However, only one type of data can be loaded each time, and the previous data will be automatically cleaned up when new data is loaded next time.

Method:

Step 1: Click "Make a variable";

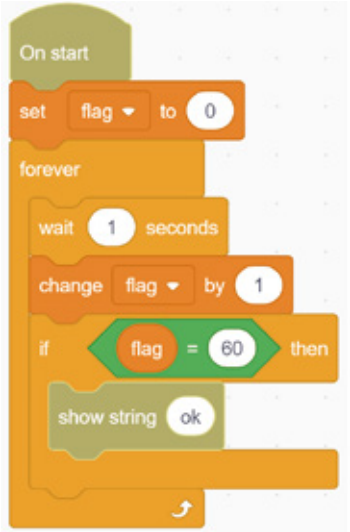
Step 2: Enter the variable name;

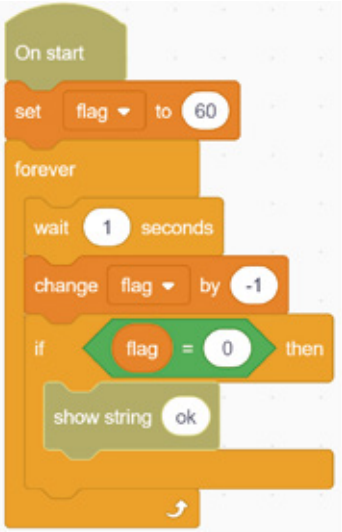
Step 3: After entering the variable name, click OK, and the following interface will appear;

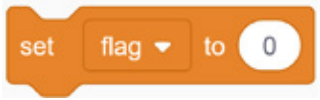


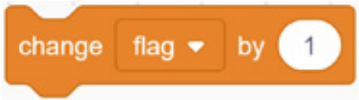
The three blocks on the picture above are commonly used, which are introduced separately here:

<table>
<tr><th>Block</th><th>Example</th></tr>
<tr><td> 

Explanation: Variable, calling the variable name means using the data in it</td><td rowspan="3"> 



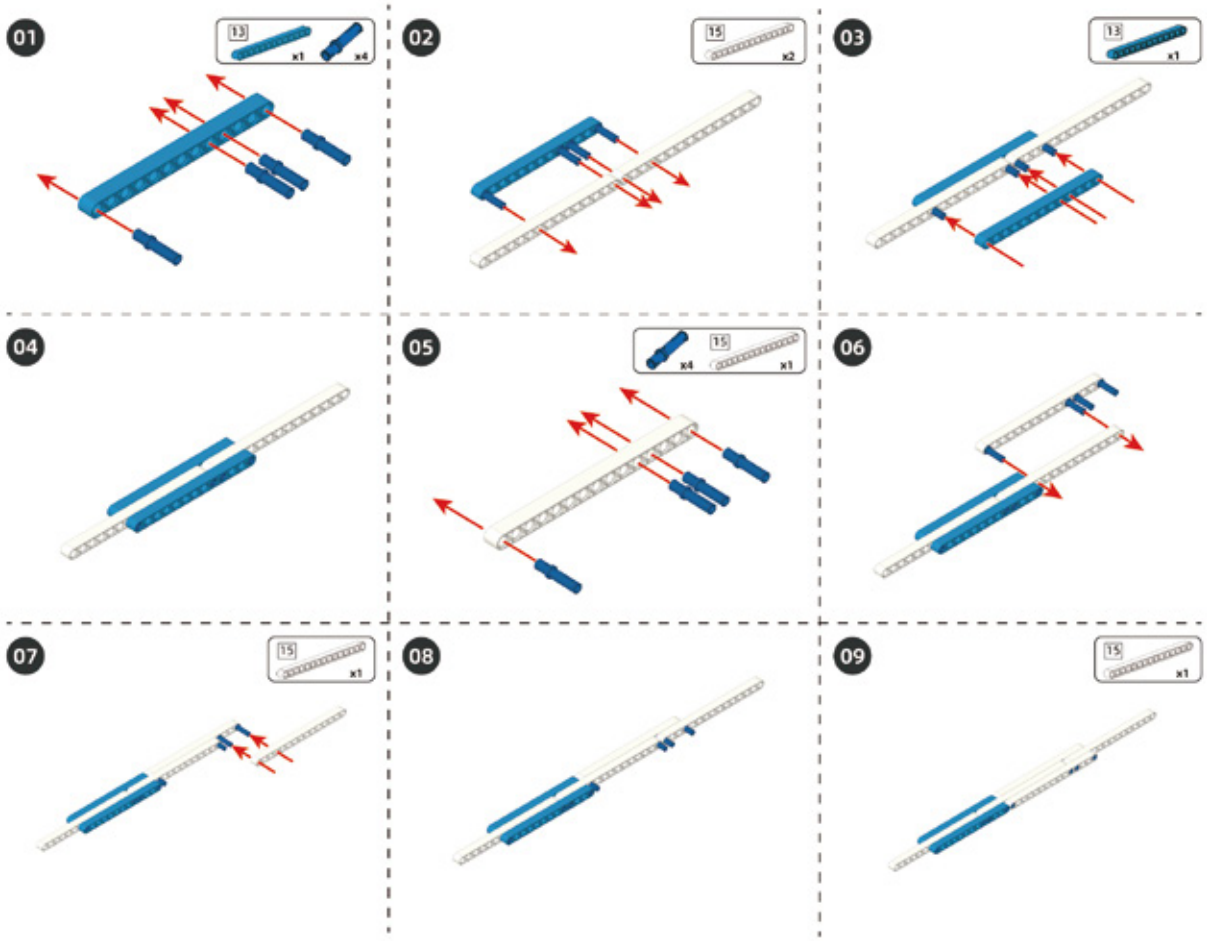
The first program is to time 60 seconds
The second program as a 60-second countdown timer</td></tr>
<tr><td> 

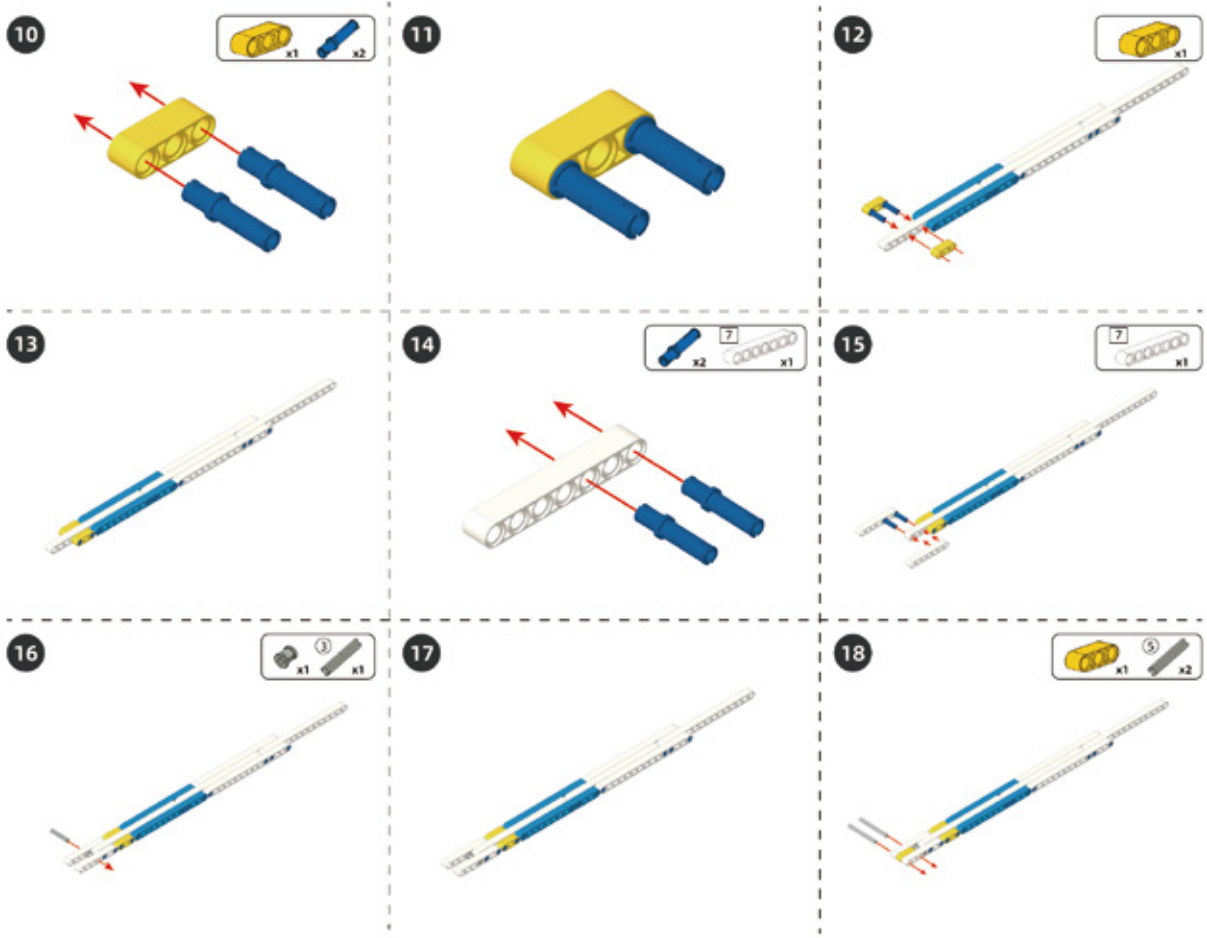
Explanation: You can assign initial values to variables and re-assign them</td></tr>
<tr><td> 

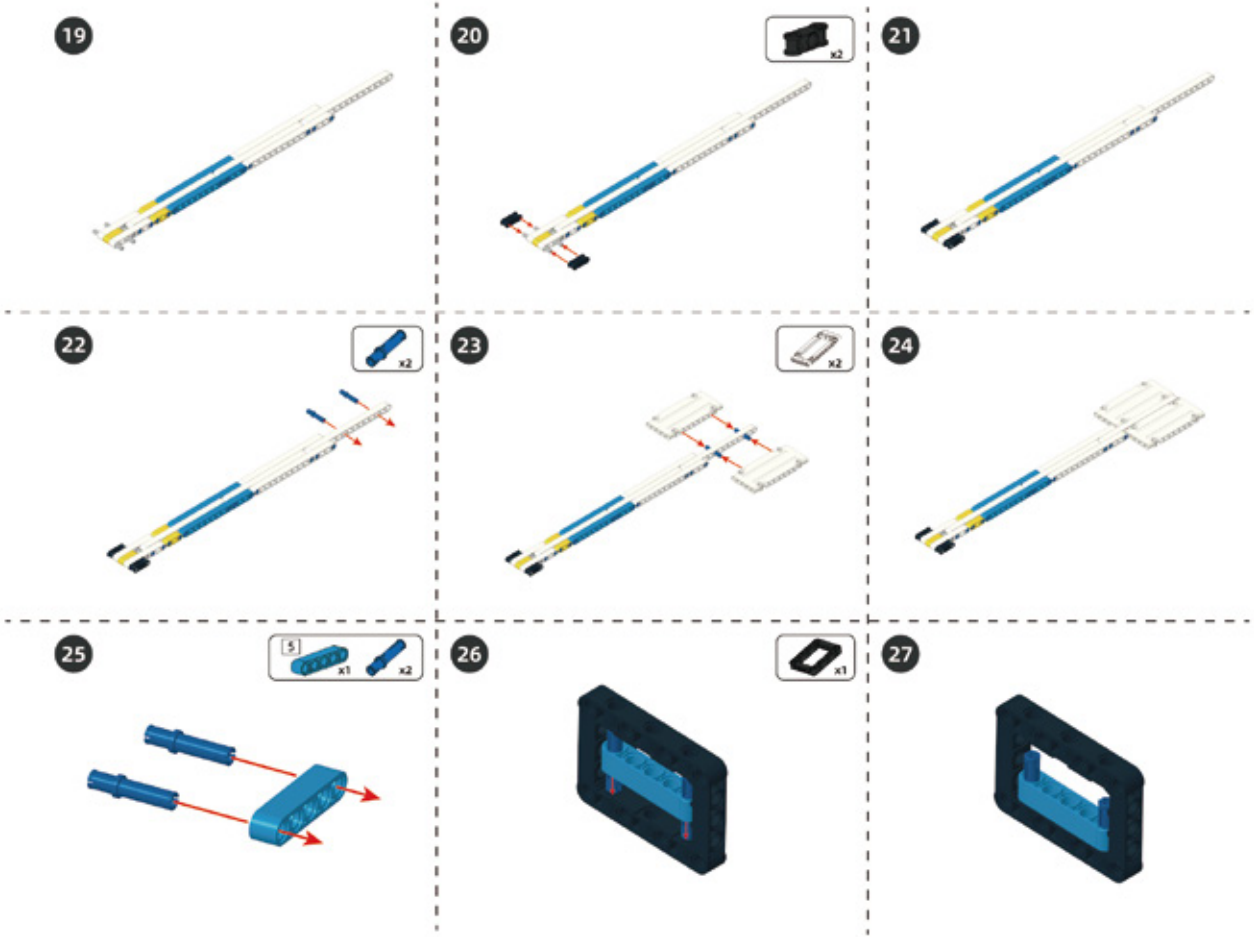
Explanation: Calculate the variables. For example, addition and subtraction, subtraction needs to adds a minus sign "-" in front of the number</td></tr>
</table>

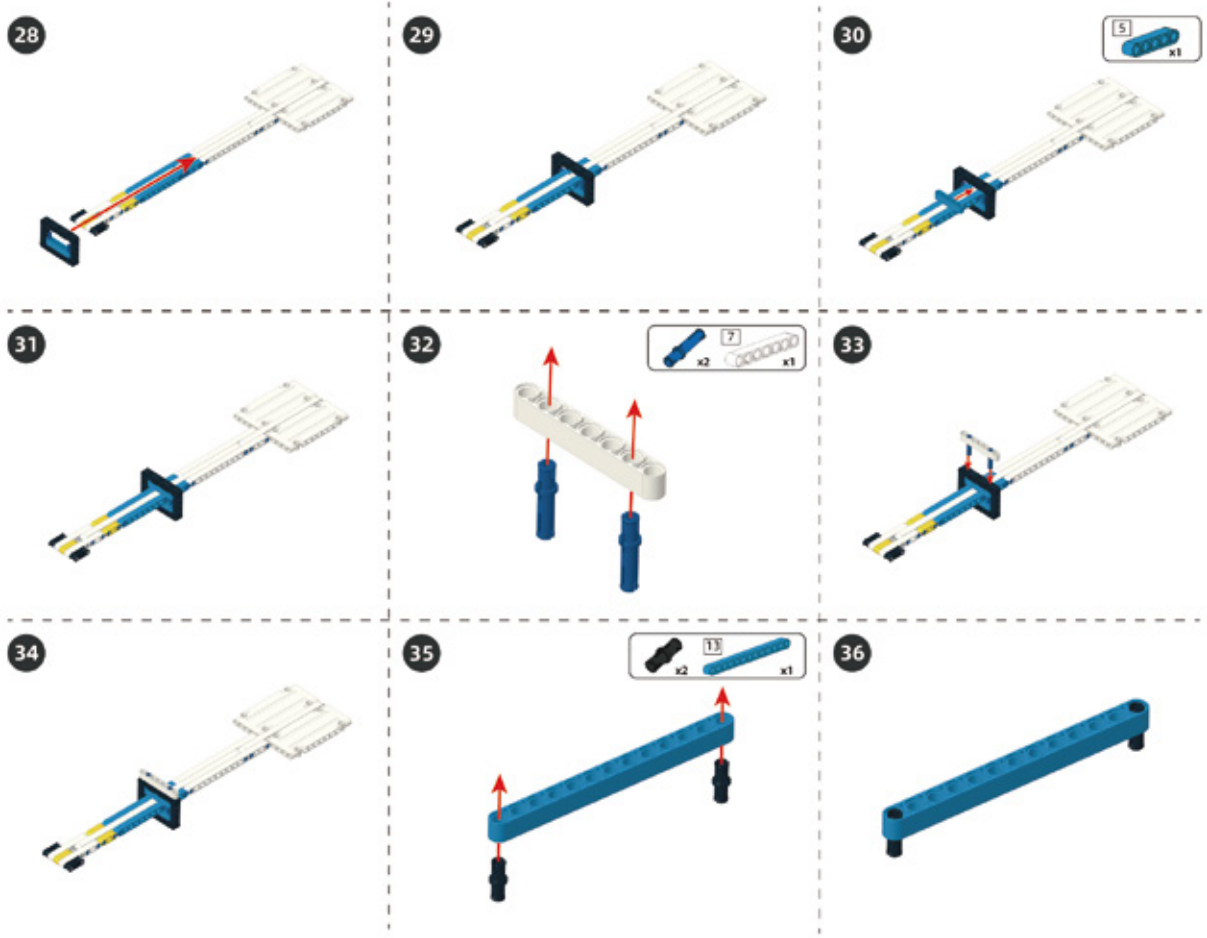
5. Model Building

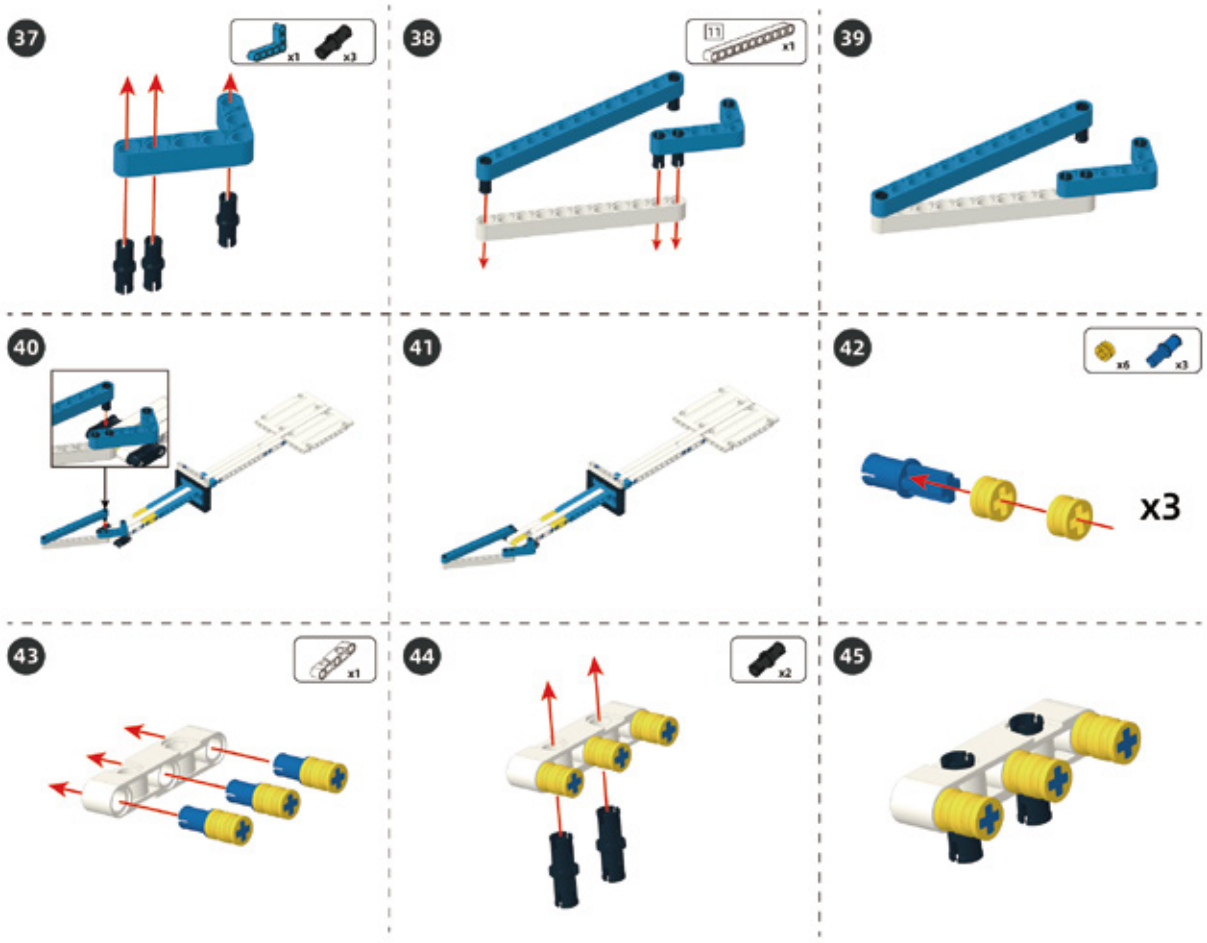
- **Structure Building**

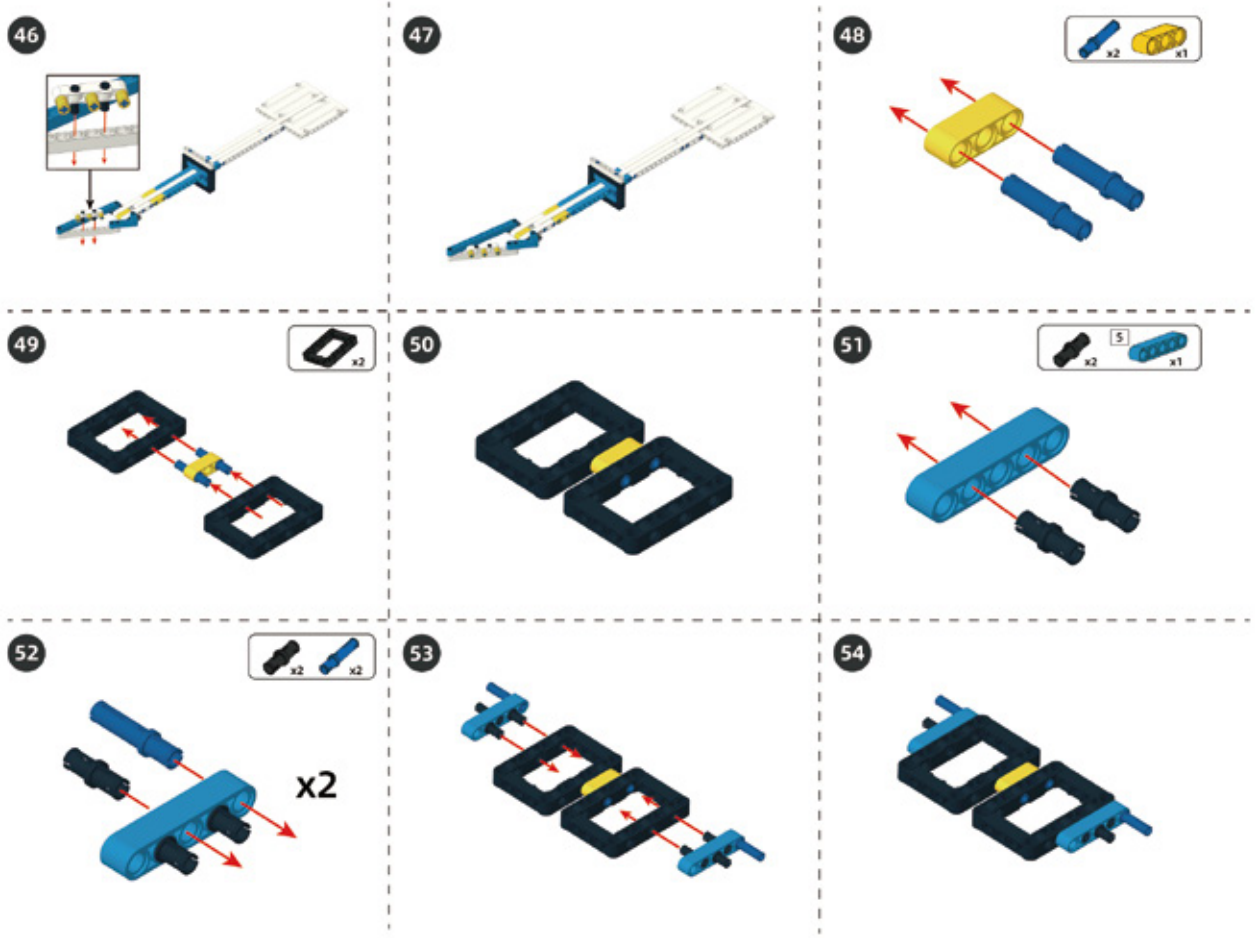

01
13
x1
x4
02
15
x2
03
13
x1
04
05
x4
15
x1
06
07
15
x1
08
09
15
x1

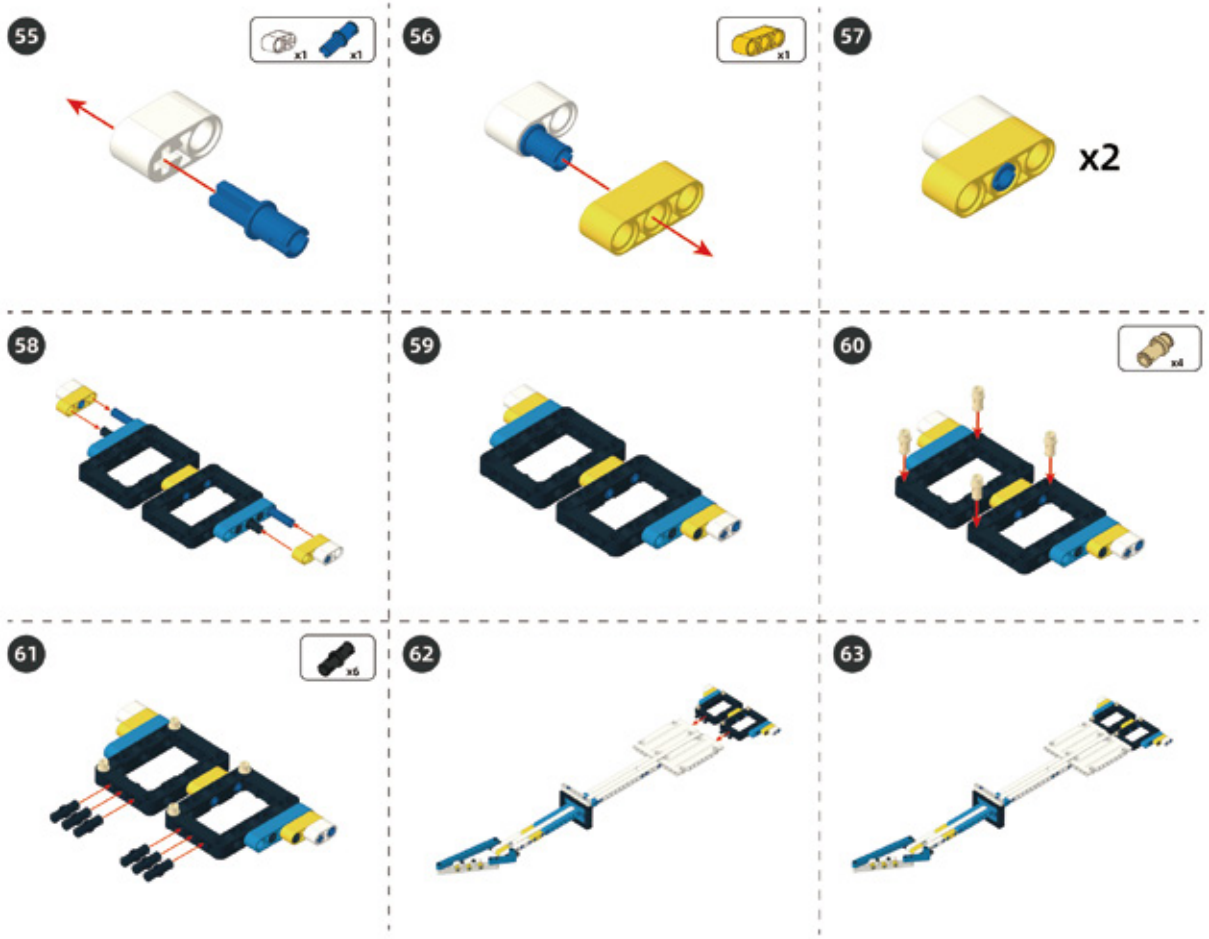

10
x1
x2
11
12
x1
13
14
7
x2
x1
15
7
x1
16
3
x1
x1
17
18
5
x1
x2

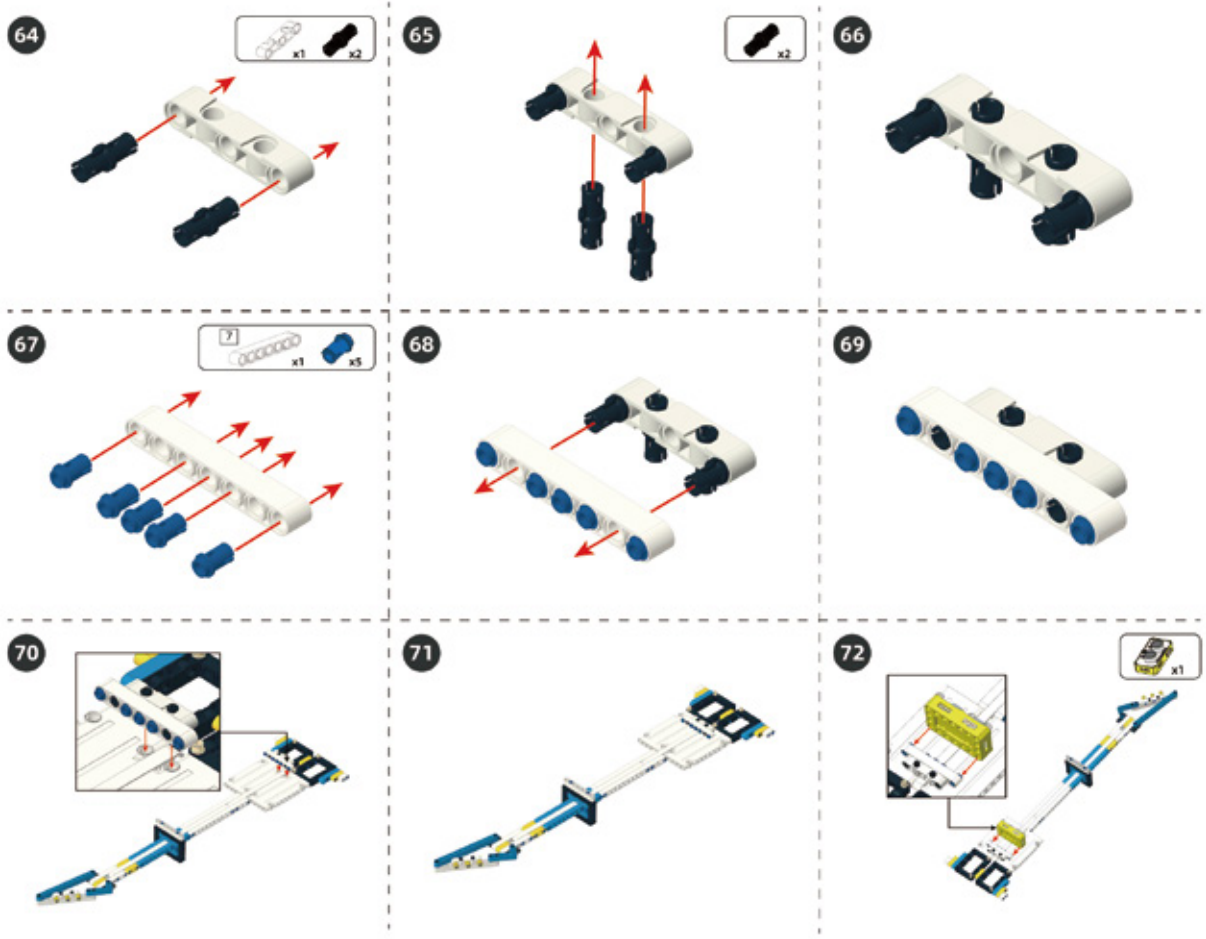

19
20
x2
21
22
x2
23
x2
24
25
5
x1
x2
26
x1
27

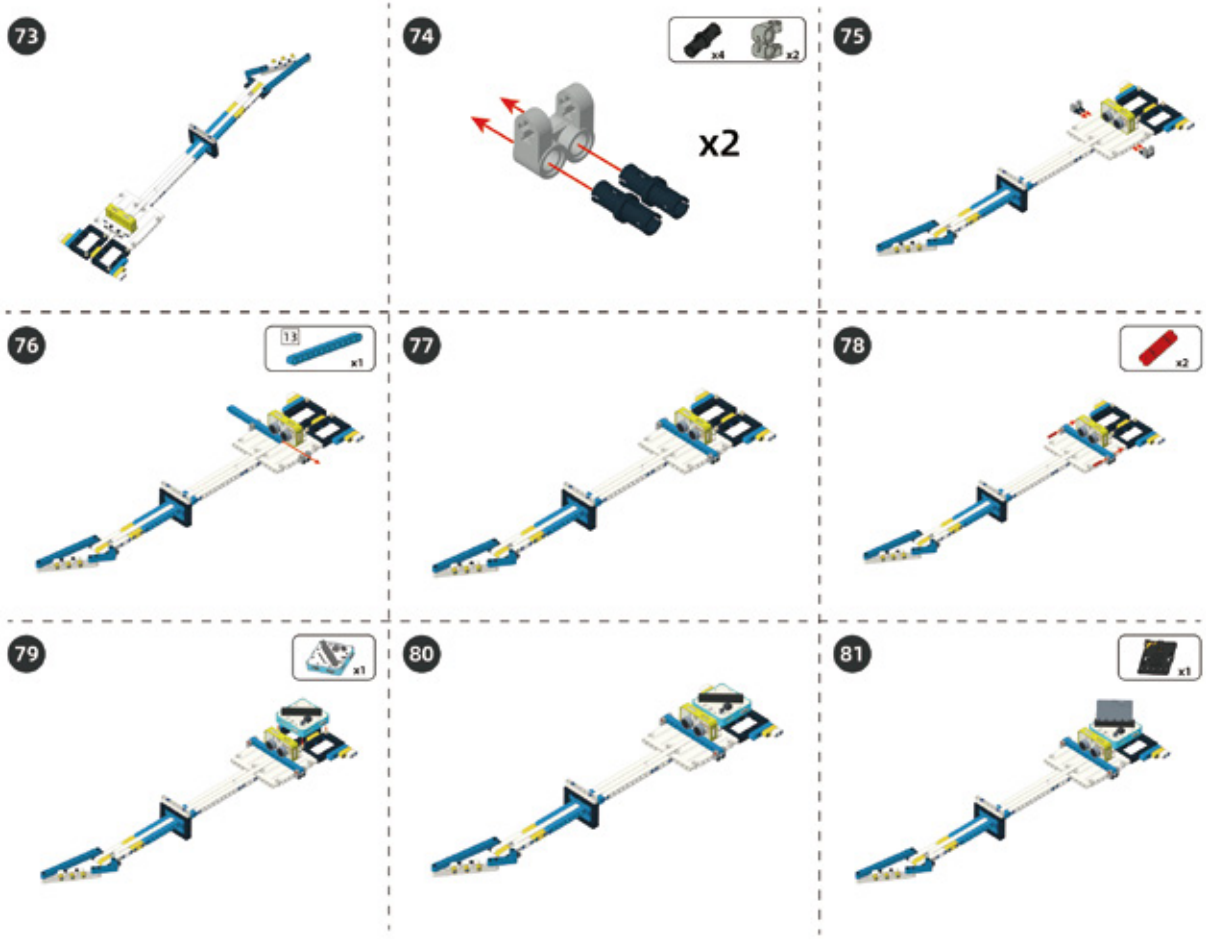

28
29
30
5
x1
31
32
7
x2
x1
33
34
35
11
x2
x1
36

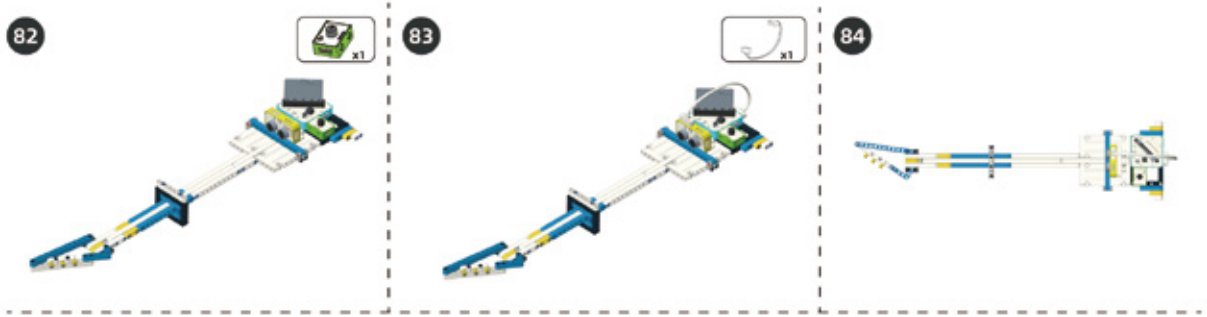

37
x1
x3
38
11
x1
39
40
41
42
x6
x3
x3
43
x1
44
x2
45

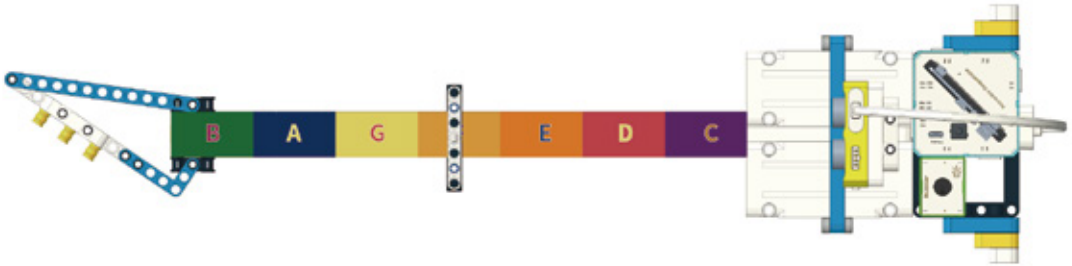

46
47
48
x2
x1
49
x2
50
51
5
x2
x1
52
x2
x2
x2
53
54


55
x1
x1
56
x1
57
x2
58
59
60
x4
61
x6
62
63


64
x1
x2
65
x2
66
67
7
x1
x5
68
69
70
71
72
x1


73
74
x4
x2
x2
75
76
13
x1
77
78
x2
79
x1
80
81
x1


82
x1
83
x1
84


B
A
G
E
D
C

• **Circuit Connection**

Connect the circuits as shown below:

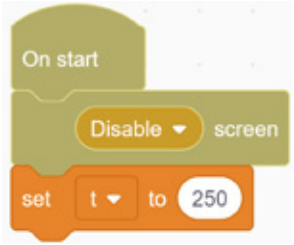
6. Task to Practice

Task Goal: Different distances correspond to different tones.

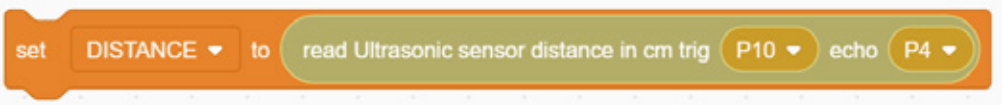
Task Analysis:

Step 1: Release the pins of the dot matrix screen firstly. If the pins you use are occupied, it will cause interference;

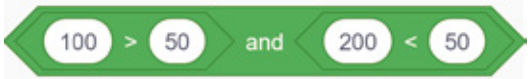
Step 2: Set the frequency of variable t;

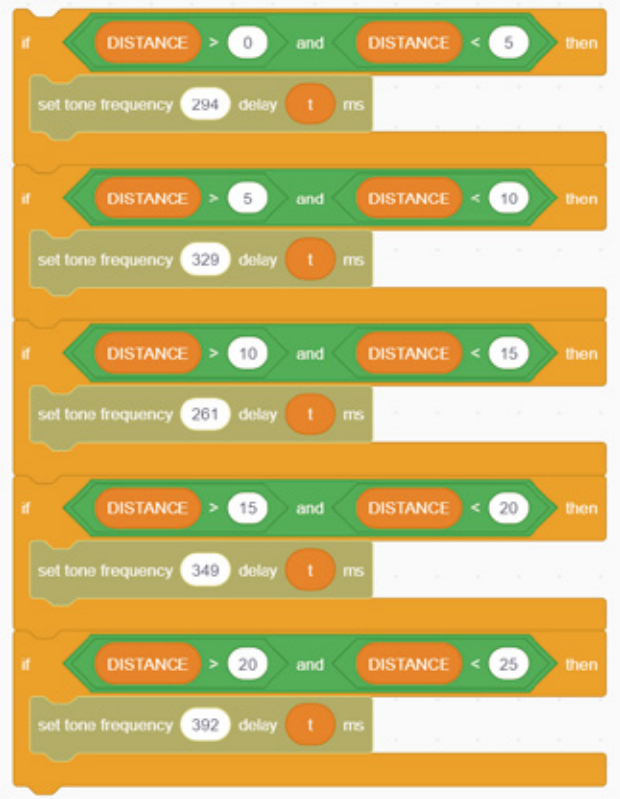


Step 3: Set the variable DISTANCE to save the distance value read by the ultrasonic ranging sensor;



Step 4: Set different pitch frequencies and their corresponding times according to different distances. New blocks need to be used, as shown below;

Block	Example
 Explanation: And operation. Determine whether both conditions are true.	 This condition is true.  This condition is not true.



Repeat this part of the code to complete the program.

For the complete program, please visit the official website to download: forum.elecrow.com.

7. Game Interactions

Have a concert with your friends and bring your DIY ultrasonic guitar.

Before that, you can modify the programs to make the guitar play a more beautiful melody, and you can also work with your friends to play a wonderful music!

8. Brainstorming

The electric guitar project uses ultrasonic ranging sensors and buzzers. Ultrasonic sensors are usually used to detect obstacles and distance measurement. For example, self-driving cars use ultrasonic waves to avoid obstacles; and buzzers are very common, any machines that need to sound an alarm may use it.

Now, let us think, what other interesting projects can you make using ultrasonic ranging sensors and buzzers?

Project 3 Automatic Obstacle Avoidance Car

1. Learning Goals

1. Know about driverless technology.
2. Learn how to use ultrasonic ranging sensor, LED light and buzzer module.
3. Complete the build and programming of ultrasonic obstacle avoidance car.

2. Application

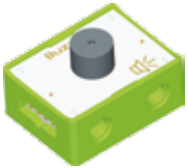
With the development of society and technological progress, driverless technology has become more and more mature. It is conceivable that in the near future, all of us can enjoy the convenience brought by driverless cars. However, do you know how driverless cars avoid obstacles?

Now, let's use building blocks and programming to make an automatic obstacle avoidance car!

3. Supplies List

• **Electronic Supplies:**

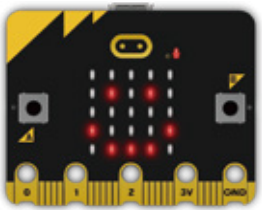
LED x1



Buzzer x1

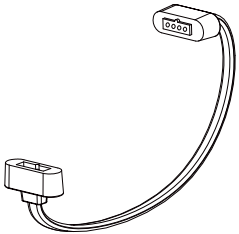
DC Motor x2

Ultrasonic Ranging Sensor x1



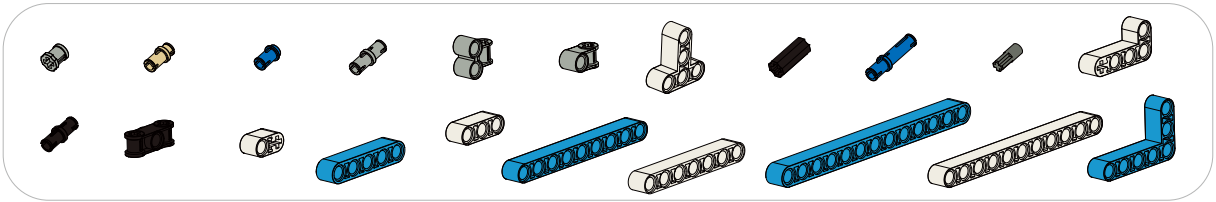
Micro:bit x1

Micro:bit Compatible x1



Magnetic Cable x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**

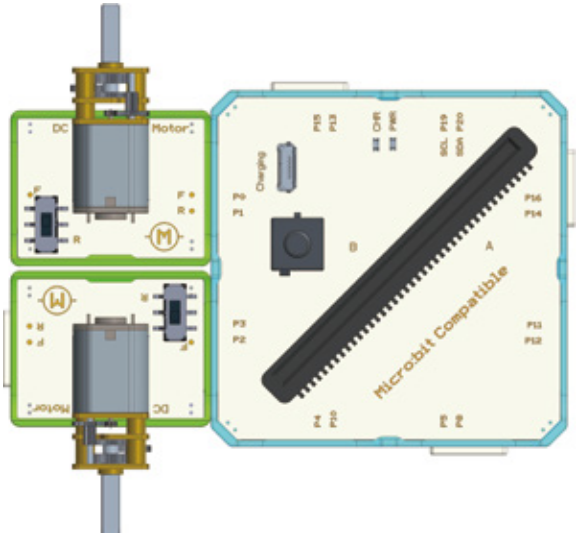


4. Knowledge Analysis

• Use of Two Motor Modules

We have learned the control of a single motor before. Next, we will learn how to control the two motors to rotate in the same direction and in the opposite direction. Note: When programming to control the motor, the toggle switch should be set to the F terminal.

Circuit Connection:

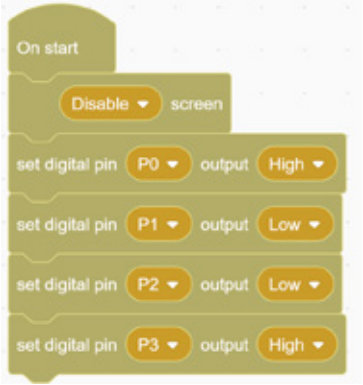


Program Driven:

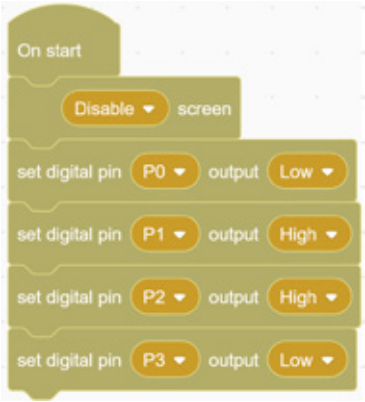
The left motor is connected to ports P0 and P1, and the right motor is connected to ports P2 and P3. When controlled by high and low levels, the rotation direction of the motor is as follows:

P0	P1	P2	P3	Direction
HIGH	LOW	LOW	HIGH	Forward
LOW	HIGH	HIGH	LOW	Backward
LOW	HIGH	LOW	HIGH	Turn left
HIGH	LOW	HIGH	LOW	Turn right

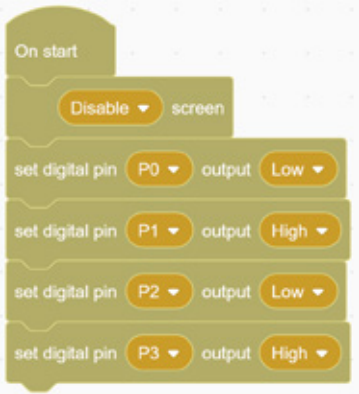
a. The program that control the car to move forward:



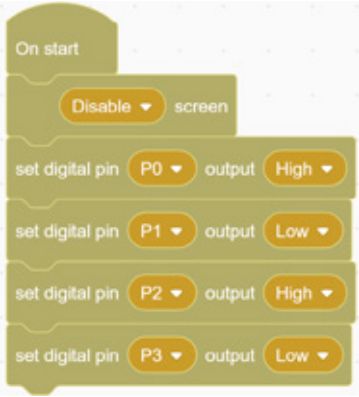
b. The program that control the car to move backward:



c. The program that control the car to turn left:



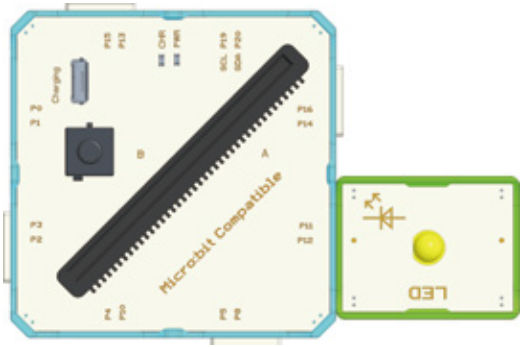
d. The program that control the car to turn right:



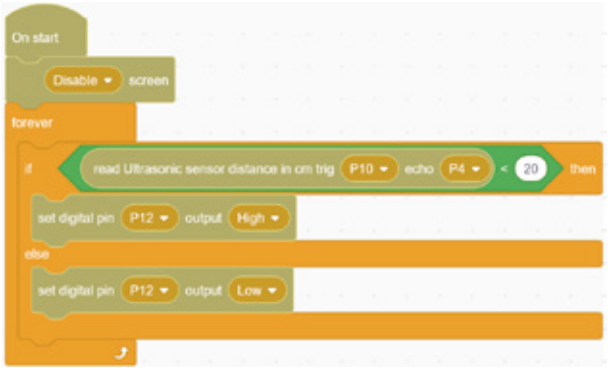
• LED

1. LED Module: It is a digital output module. When input high level 1, the light is on. When input low level 0, the light is off.

2. Circuit Connection:

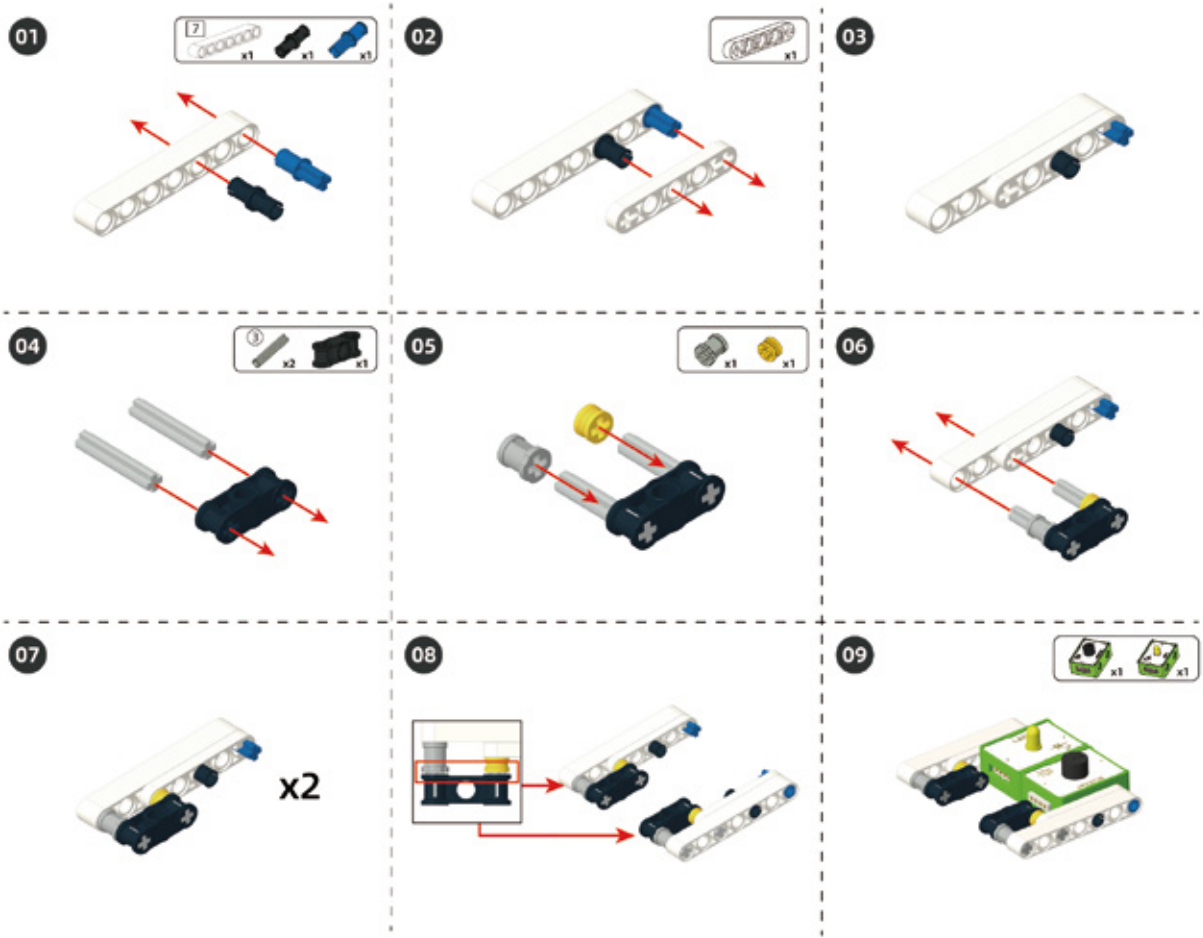


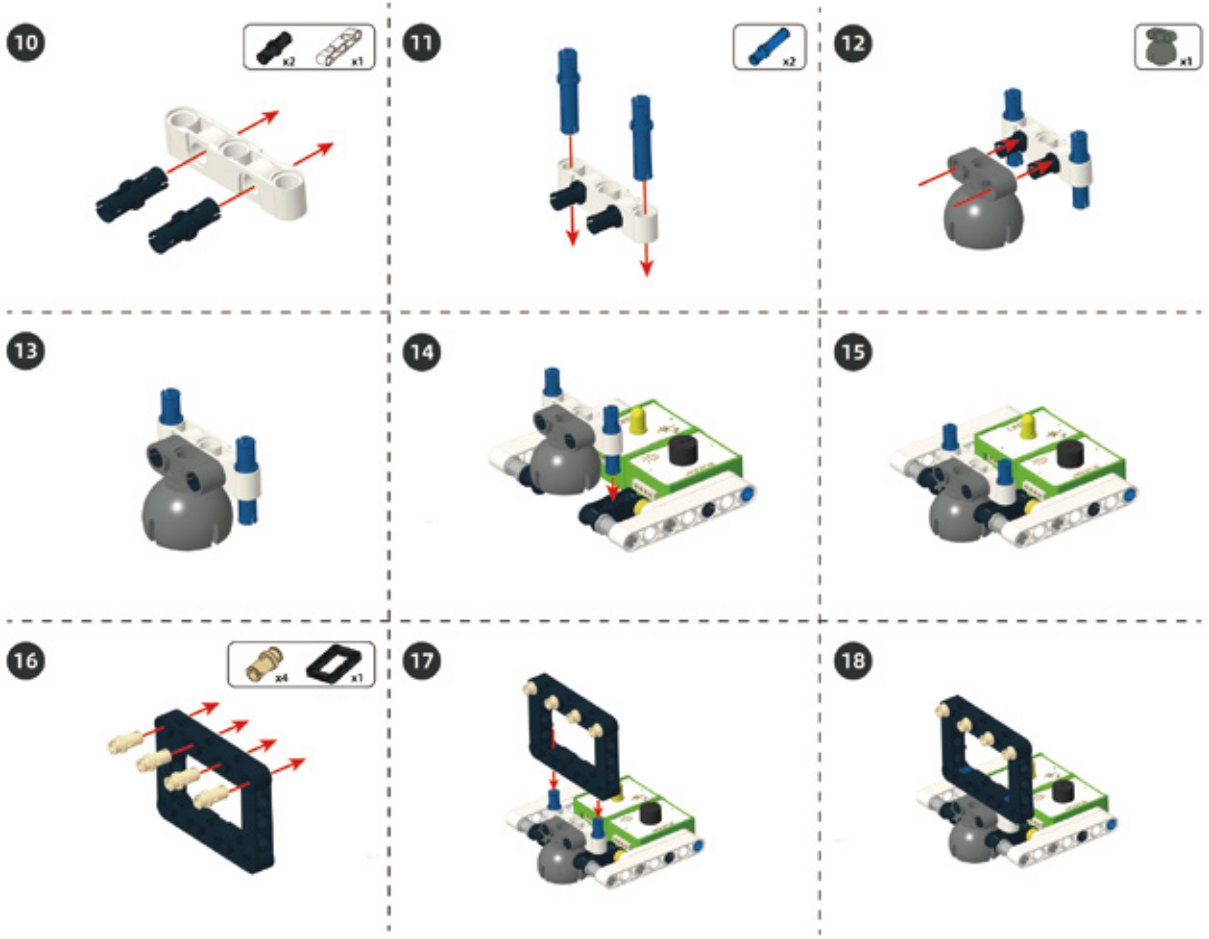
For example, you want to achieve: if "the distance between the ultrasonic and the obstacle is less than 20cm", then "LED light is on", otherwise "LED light is off".



5. Model Building

• Structure Building


01
x1
x1
x1
02
x1
03
04
x2
x1
05
x1
x1
06
07
x2
08
09
x1
x1


10
x2
x1
11
x2
12
x1
13
14
15
16
x4
x1
17
18

19

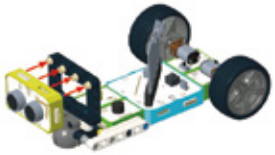
20

21

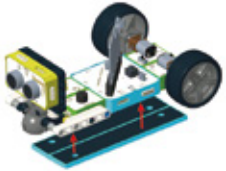
22

23

24

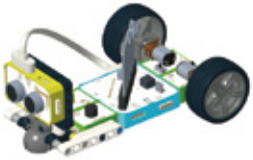


25



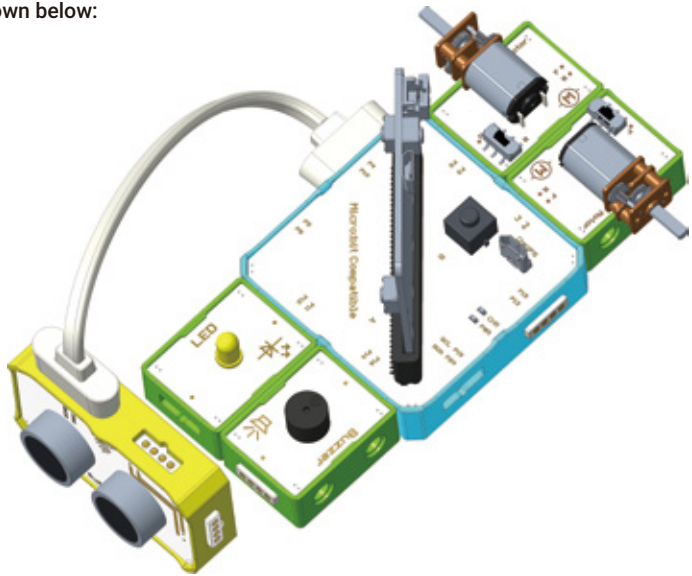
26

27



• **Circuit Connection**

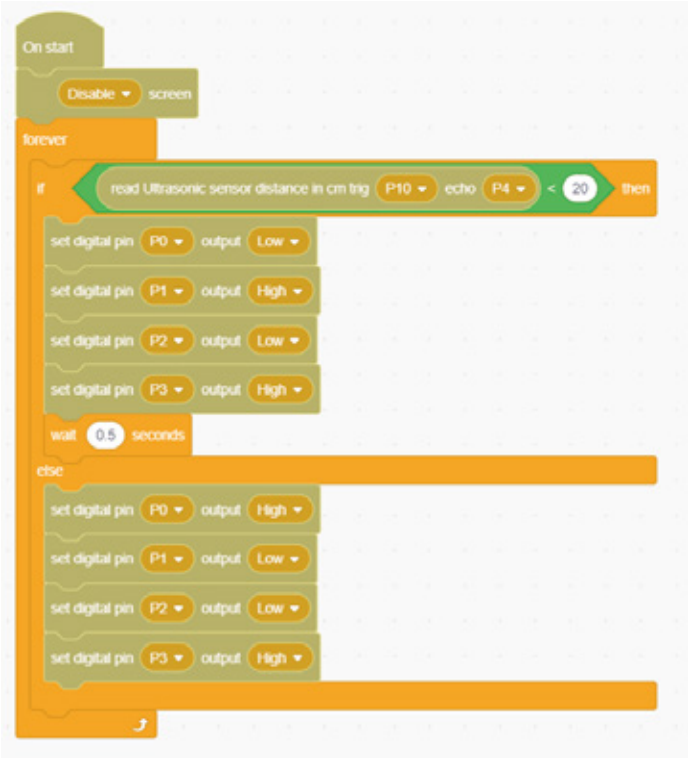
Connect the circuits as shown below:



6. Task to Practice

Task Goal: The car will avoid obstacles.

Task Analysis: If the distance between the Ultrasonic ranging sensor and the obstacle is less than 20cm, then the car turns left or turn right, otherwise the car moves forward.



Additional Task: When the car detects an obstacle in front of it, it will turn automatically with special warning effects, that is, LED light flashes and buzzer sounds at the same time.

For the complete program, please visit the official website to download: forum.elecrow.com.

7. Game Interactions

Invite your friends to use abandoned boxes or wooden boards to build a simple maze at home, and compete for whose car can get out of the maze the fastest.

8. Brainstorming

In the previous section, we made a horizontal bar project using a motor combined with an IR reflective sensor module, and a guitar project using ultrasonic and buzzer. Here we used ultrasonic, motor, LED and buzzer modules to make an automatic obstacle avoidance car project.

Creativity comes from life, and it also serves life. In daily life, we can see blind people walking on the road, but they can't see anything and don't know if there are obstacles ahead, which makes them difficult. Can you use ultrasonic ranging sensors and buzzers to design smart navigators for the blind?

Project 4 Gesture Control Car

1. Learning Goals

1. Know the application of gesture sensor.
2. Learn how to use gesture sensor module.
3. Complete the build and programming of gesture control car.

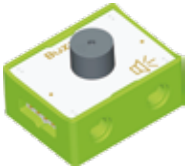
2. Application

Imagine that, when you are driving and want to open the windows of the car, you only need to raise your hand to complete it; when the night comes and you want to turn on the lights, you just need to wave your hand to achieve it instantly. These operations are based on gesture recognition, which not only increases the convenience of the driver but also bring more safety.

Next, let's make a gesture control car.

3. Supplies List

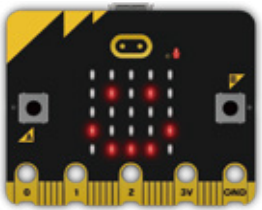
• **Electronic Supplies:**



Buzzer x1

LED x1

DC Motor x2

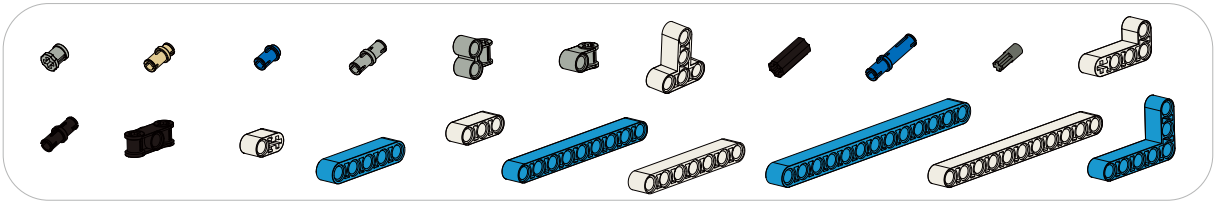


Micro:bit x1

Micro:bit Compatible x1

Gesture Sensor x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**

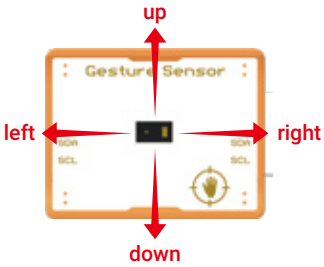


4. Knowledge Analysis

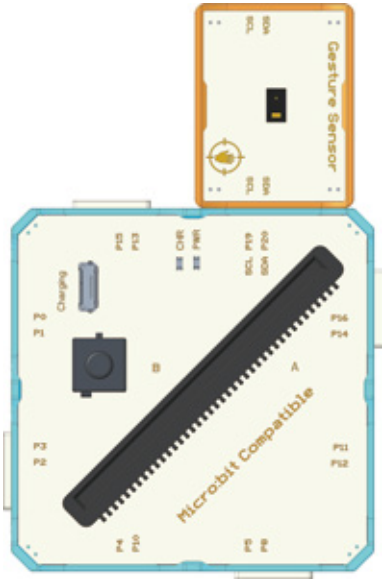
• Gesture Sensor Module:

1. Gesture Sensor: It is an IIC module that can recognize the direction of hand movement. It can recognize 9 gestures, including moving up, moving down, moving left, moving right, moving forward, moving backward, rotating clockwise, rotating counterclockwise, waving. It should be noted that the direction of the gesture sensor has nothing to do with the actual installation direction. The direction in the program should be strictly as shown in the lower right figure.

Note: When using the IIC module, you need to connect the module and turn on the power before downloading the program.

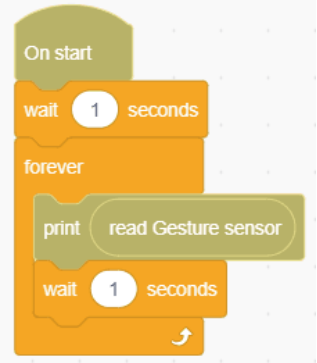


2. Circuit Connection:



3. Program Driven:

Try to print the gesture sensor information through the serial port, as shown below:

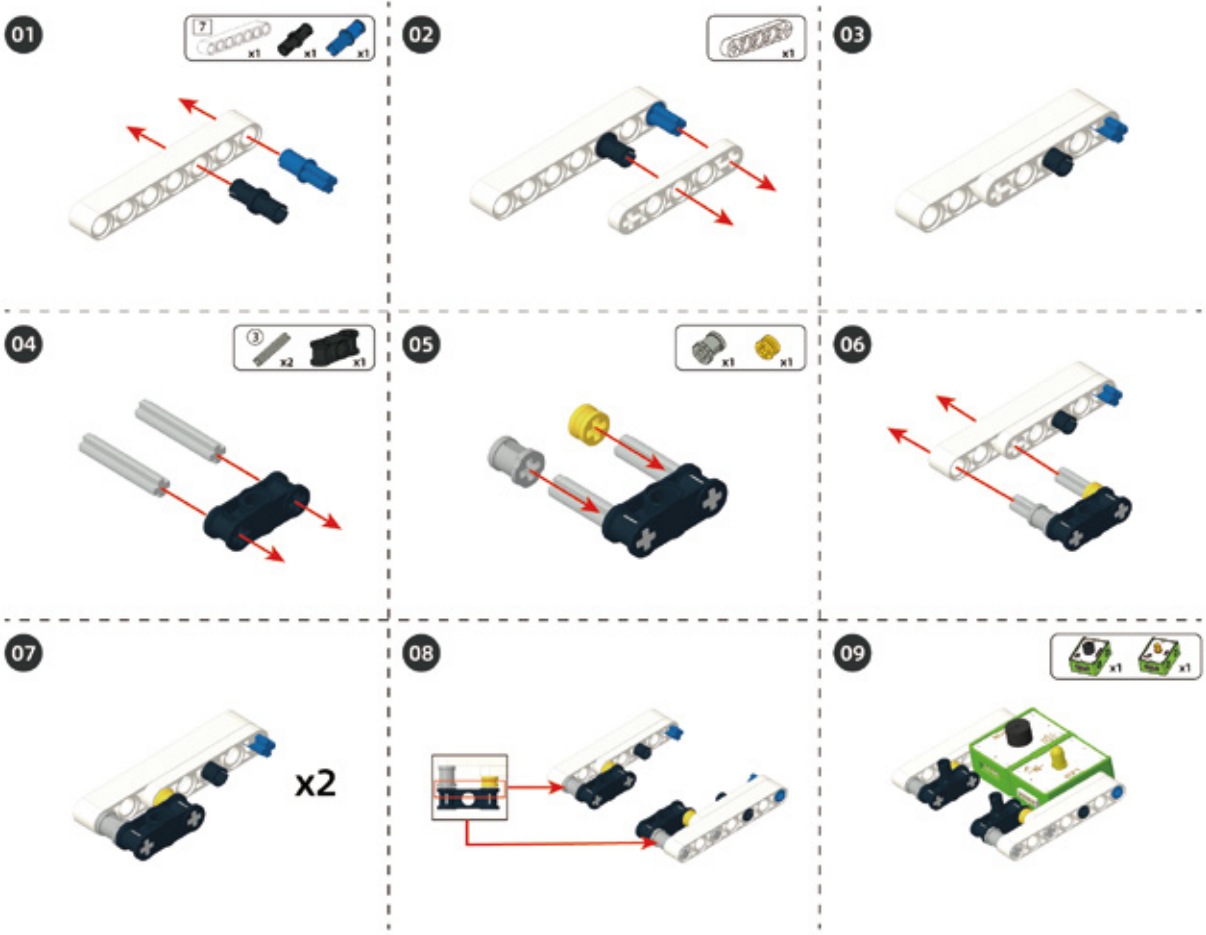


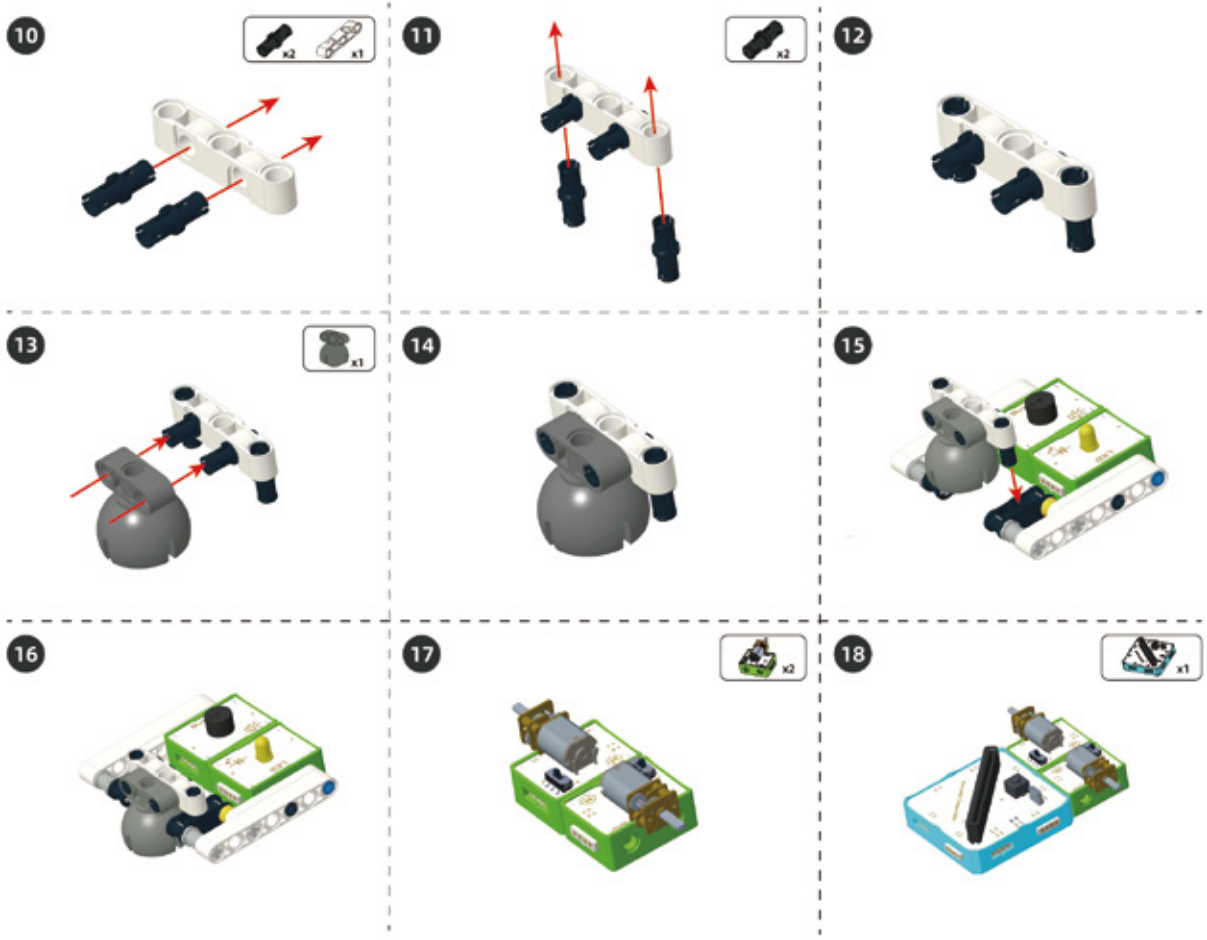

```
up
none
down
```

When the hand is waving upwards, the string "up" will be returned, when the hand is waving downwards, it will return "down", and when it is not moving, it will return "none". The same goes for forward, backward, left, and right.

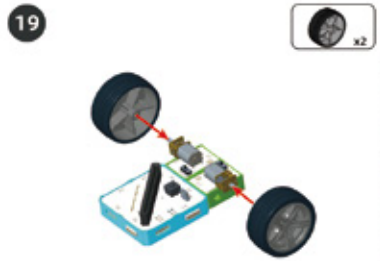
5. Model Building

- **Structure Building:**


01
7
x1
x1
x1
02
x1
03
04
3
x2
x1
05
x1
x1
06
07
x2
08
09
x1
x1


10
x2
x1
11
x2
12
13
x1
14
15
16
17
x2
18
x1

19



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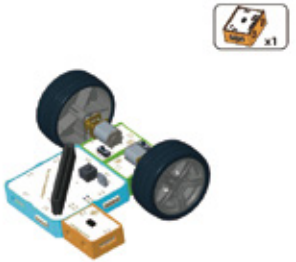
21



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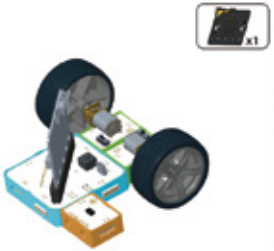

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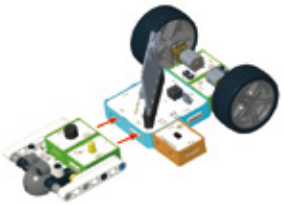
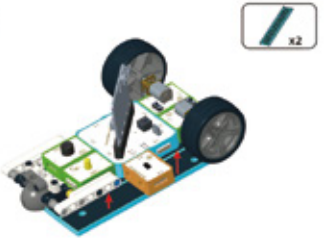


24



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26

27

• **Circuit Connection**

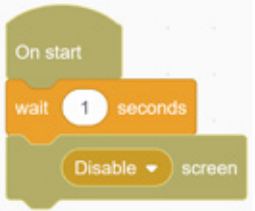
Connect the circuits as shown below:

6. Task to Practice

Task Goal: Use gestures to control the car.

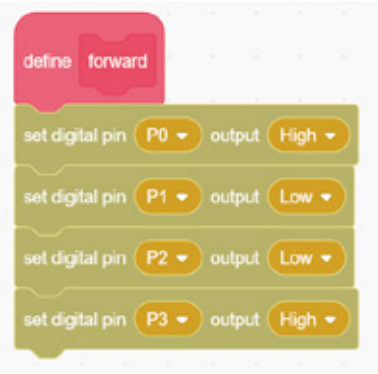
Task Analysis:

Step 1: Initialize and release the pin;

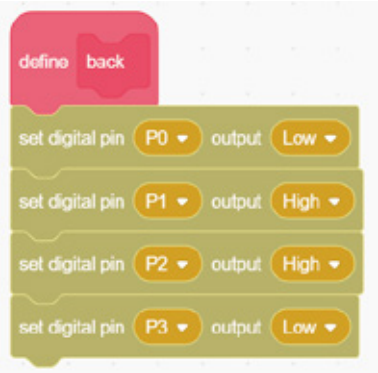


Step 2: Define four custom blocks for the car to move forward, backward, left, and right;

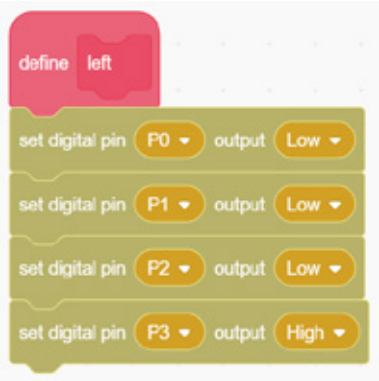
forward



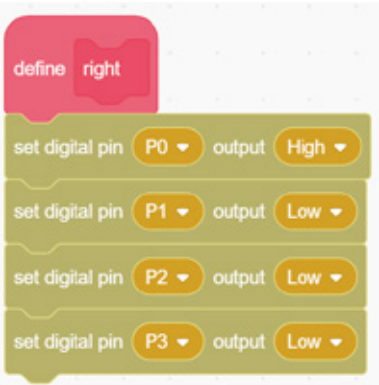
back



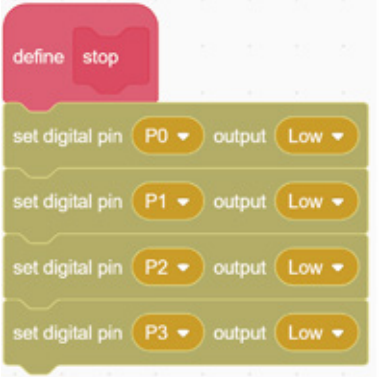
left



right



stop



Step 3: Judge movement direction of the gesture sensor and call the corresponding function;

Additional tasks:

Function 1: Gesture “forward”, LED light on constantly;

Function 2: Gesture “backward”, LED light flashes at a frequency of 1 time per second.

For the complete program, please visit the official website to download: forum.elecrow.com.

7. Game Interactions

Invite your friends to play a maze game with a car together!

Game rules: On a map with a starting and ending point, one partner is responsible for setting up a roadblock between the two points, and the other partner controls the car and starts from the starting point. Control the car to cross the obstacles to reach the destination with gestures.

8. Brainstorming

The gesture control car project uses gesture sensors, motors and LED light modules, the most important of which is the gesture sensor. Combined the electronic modules you have learned before, let's give full play to your creativity and try to modify your gesture control car. For example, add an ultrasonic ranging sensor module to make a two-in-one smart car, which can avoid obstacles and be controlled by gestures.

Project 5 Automatic Door

1. Learning Goals

1. Know the operating principle of Automatic door.
2. Review Gesture Sensor.
3. Complete the building and programming of the automatic door.

2. Application

When you approach a door, it opens suddenly, but closes again after you enter. This is the automatic door.

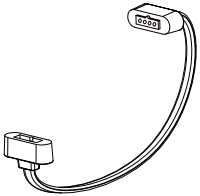
Do you know how the automatic door work? Let's make an automatic door with gesture sensor to unlock the mystery!

3. Supplies List

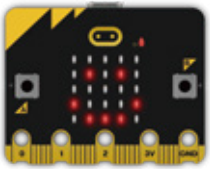
• **Electronic Supplies:**

Gesture Sensor x1

DC Motor x1



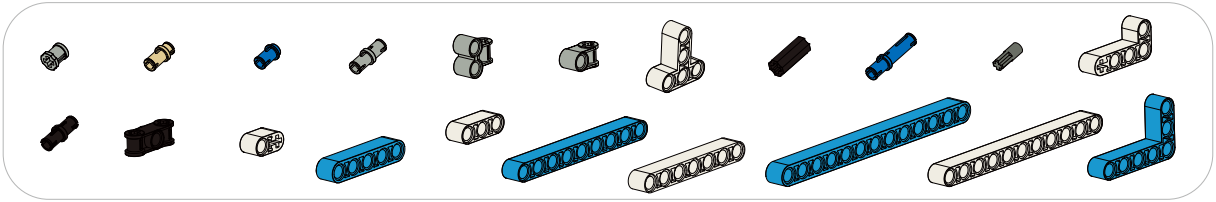
Magnetic Cable x2



Micro:bit x1

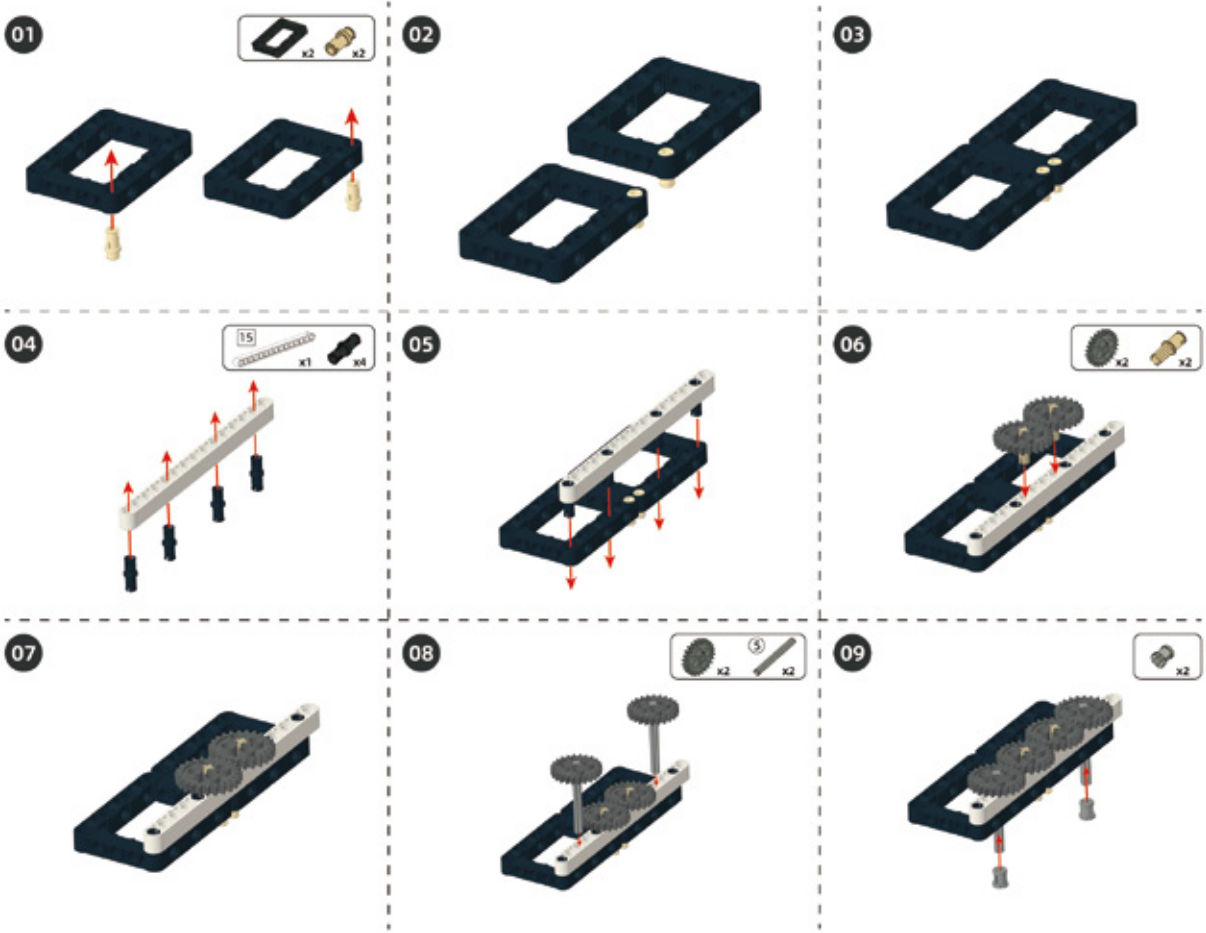
Micro:bit Compatible x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



4. Model Building

• **Structure Building:**


01
x2
x2
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x2
07
08
x2
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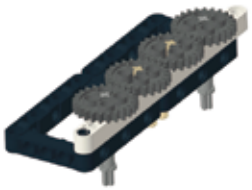
x2
09
x2

10



11

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14

x2

15

16

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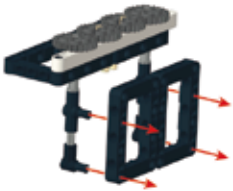

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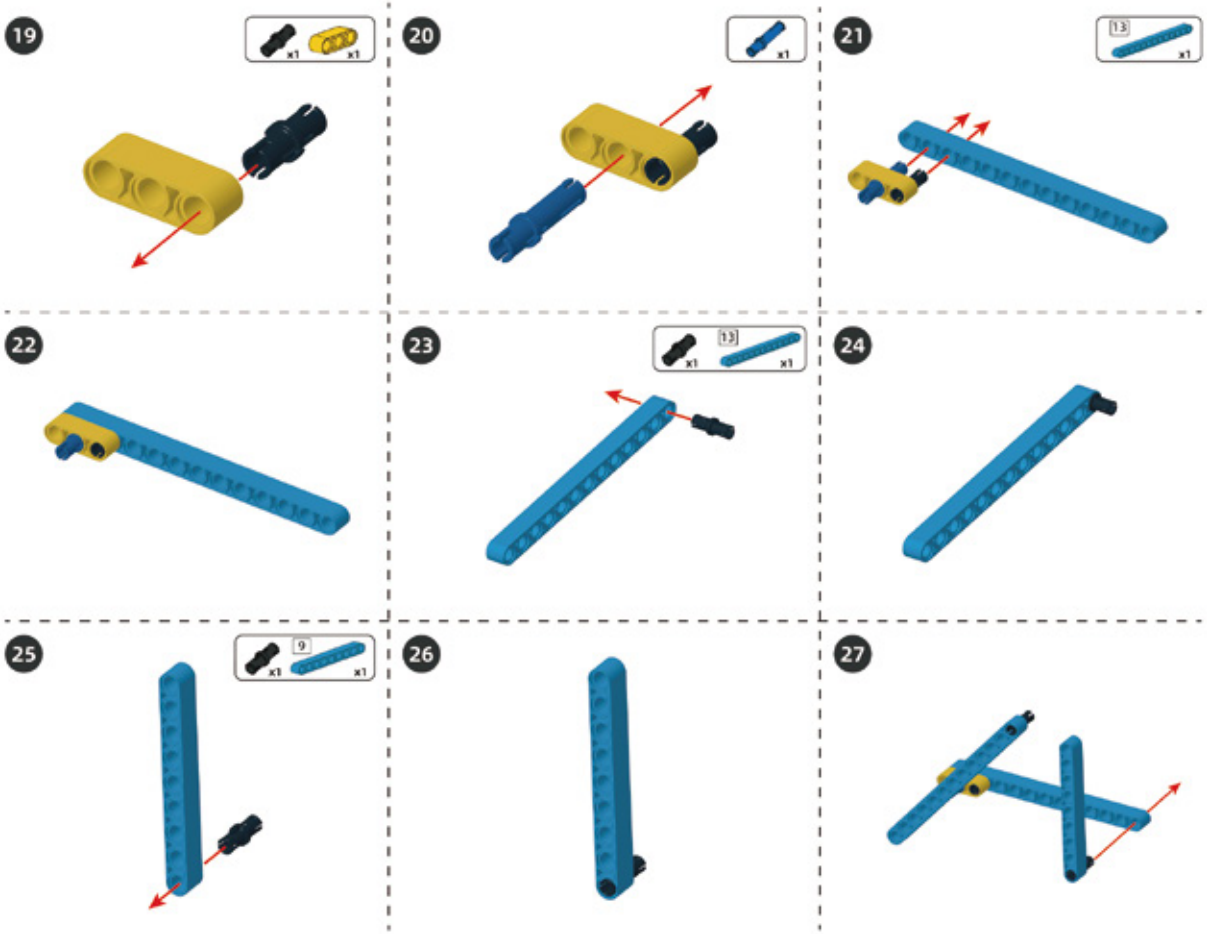
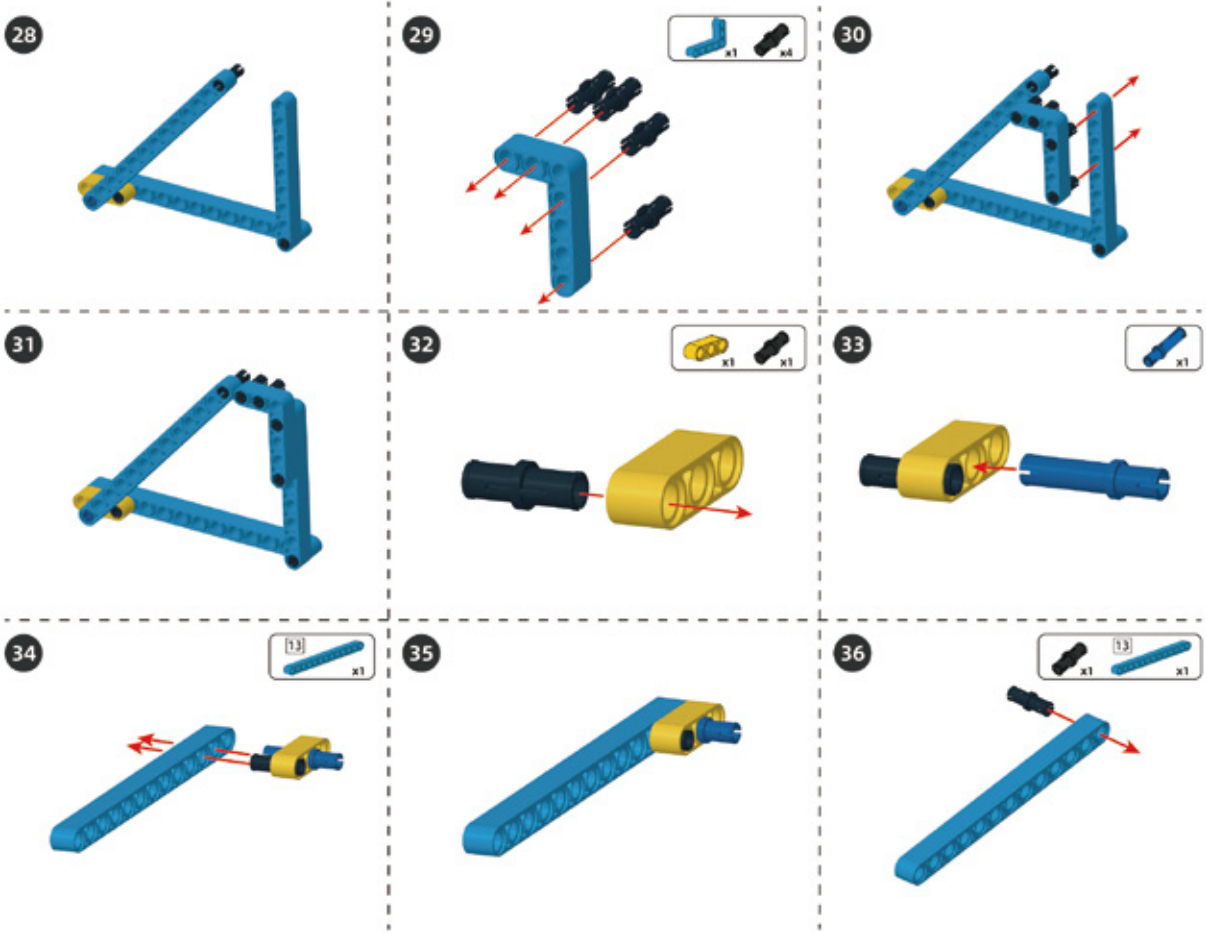
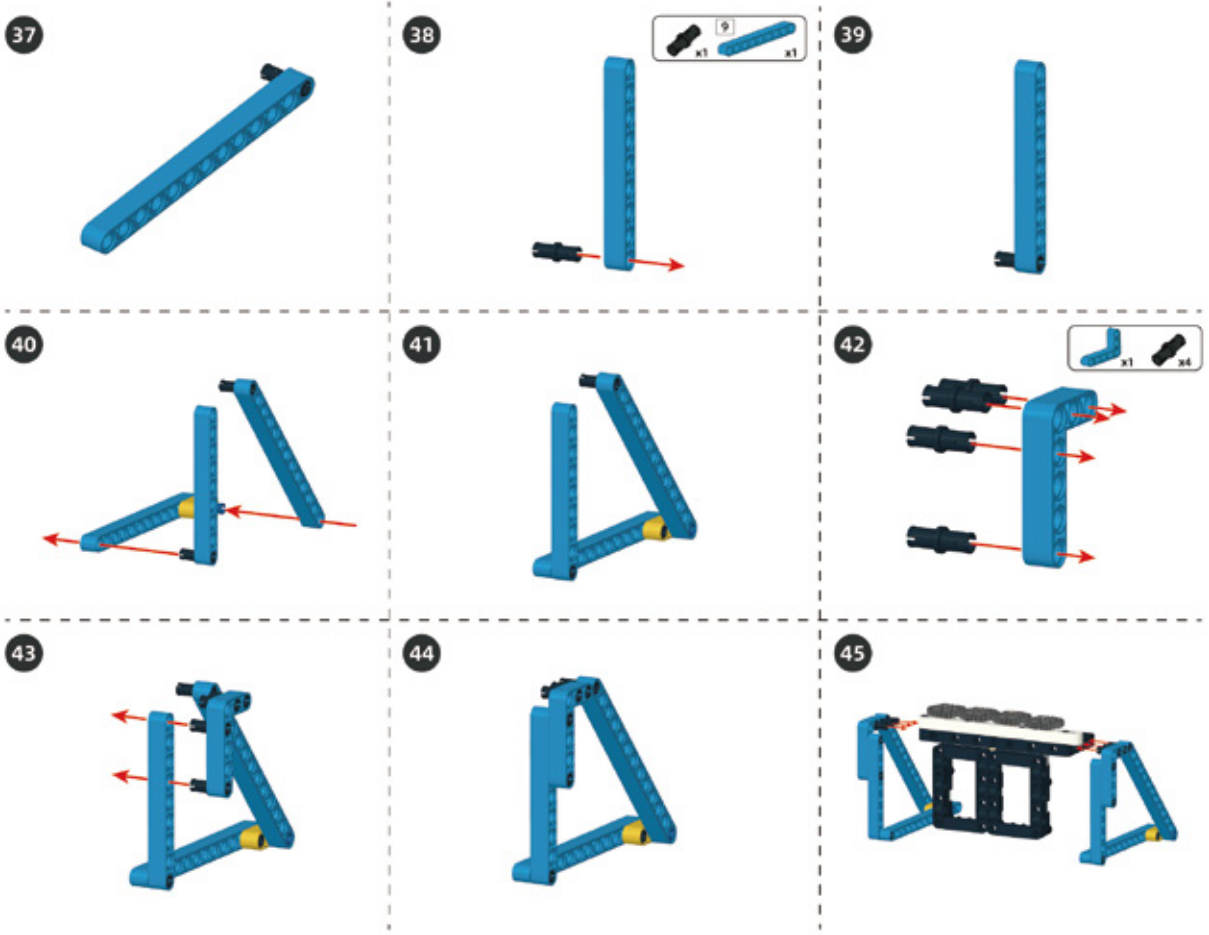
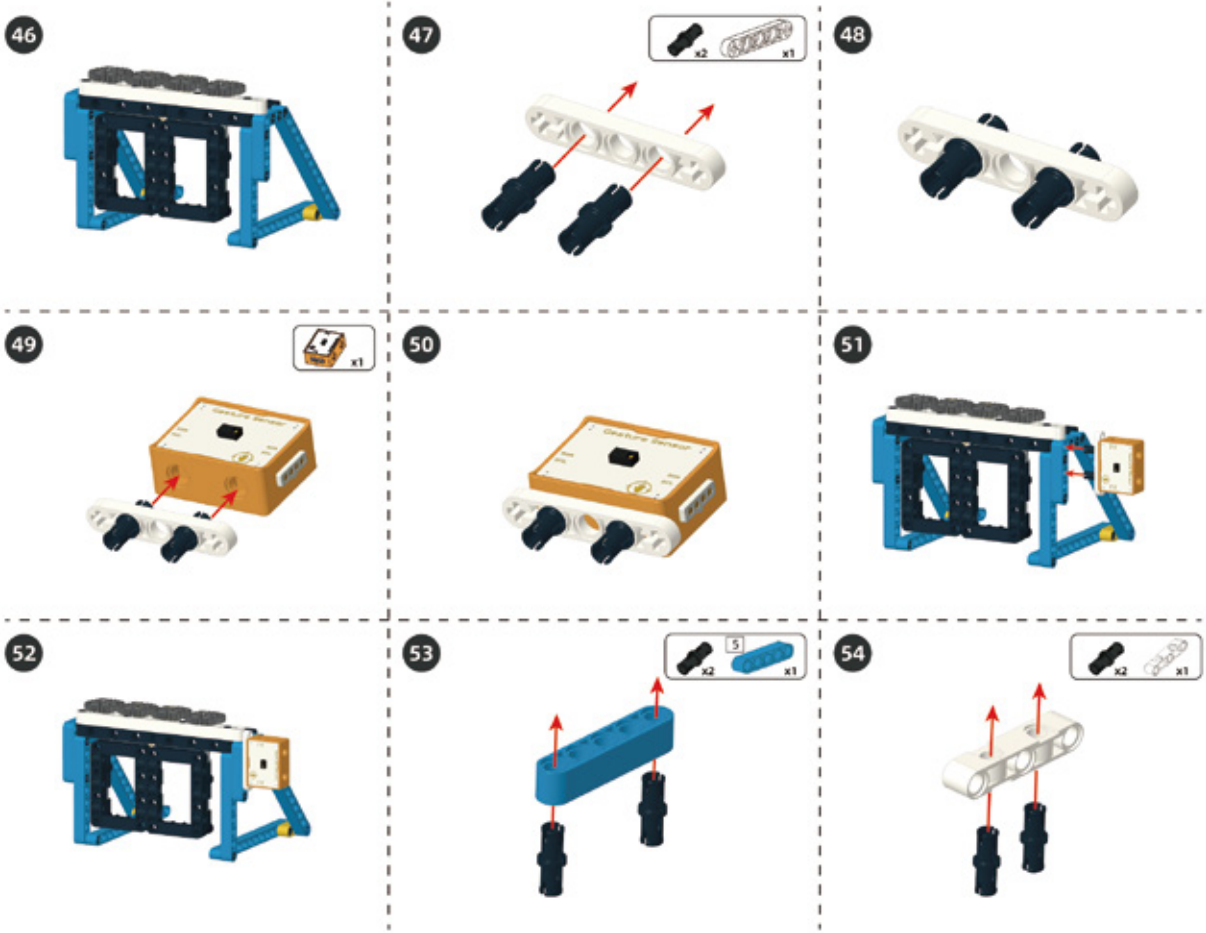
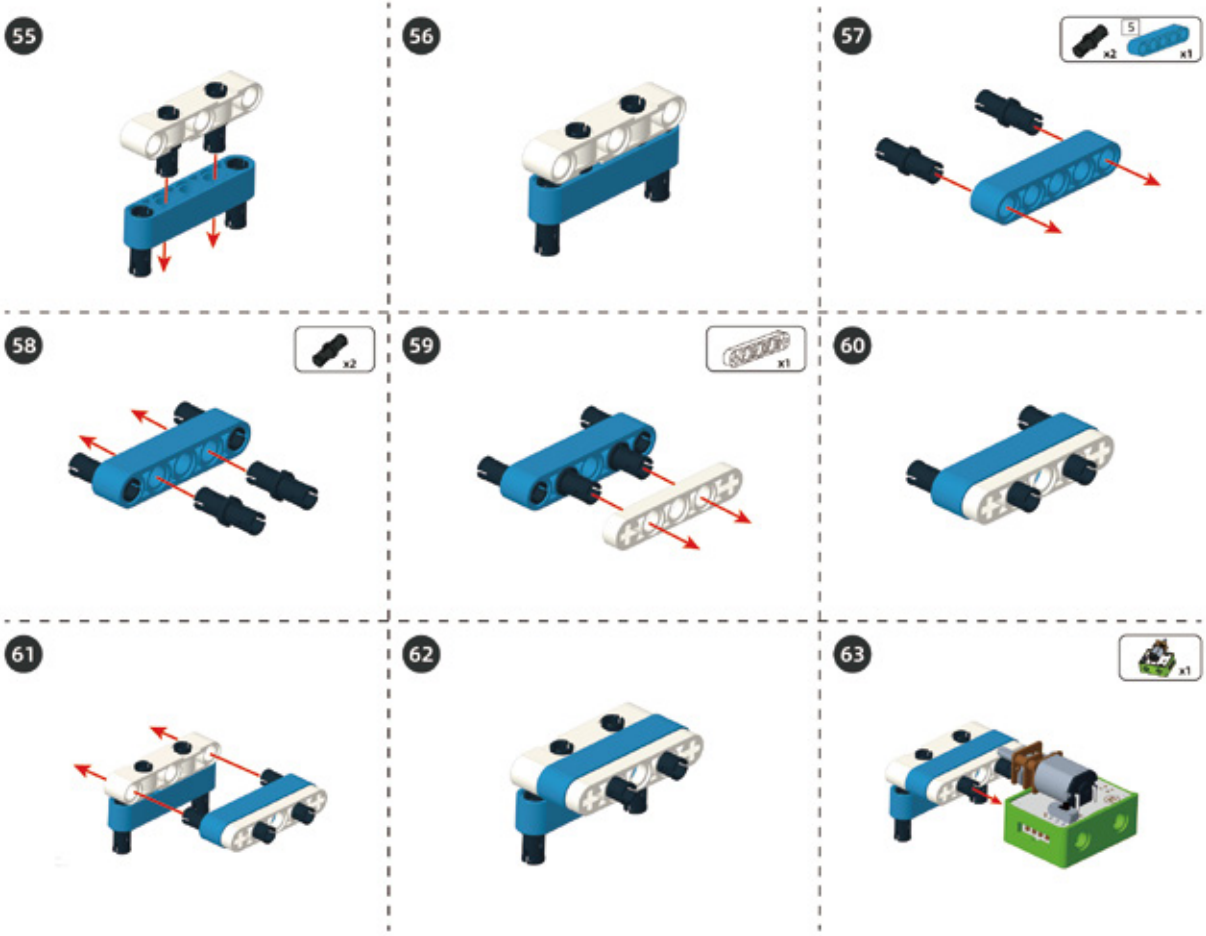

19
x1
x1
20
x1
21
13
x1
22
23
x1
13
x1
24
25
x1
9
x1
26
27


28
29
x1
x4
30
31
32
x1
x1
33
x1
34
13
x1
35
36
x1
13
x1


37
38
x1
9
x1
39
40
41
42
x1
x4
43
44
45


46
47
x2
x1
48
49
x1
50
51
52
53
5
x2
x1
54
x2
x1

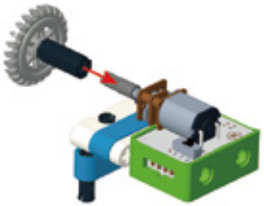

55
56
57
x2
5
x1
58
x2
59
x1
60
61
62
63
x1

64

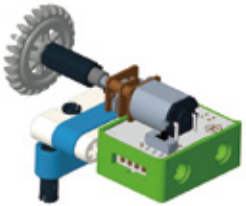
65

66

67



68



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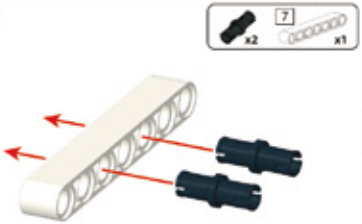

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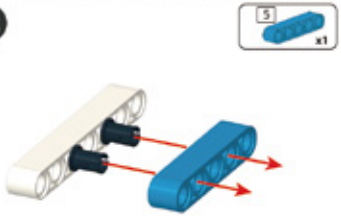
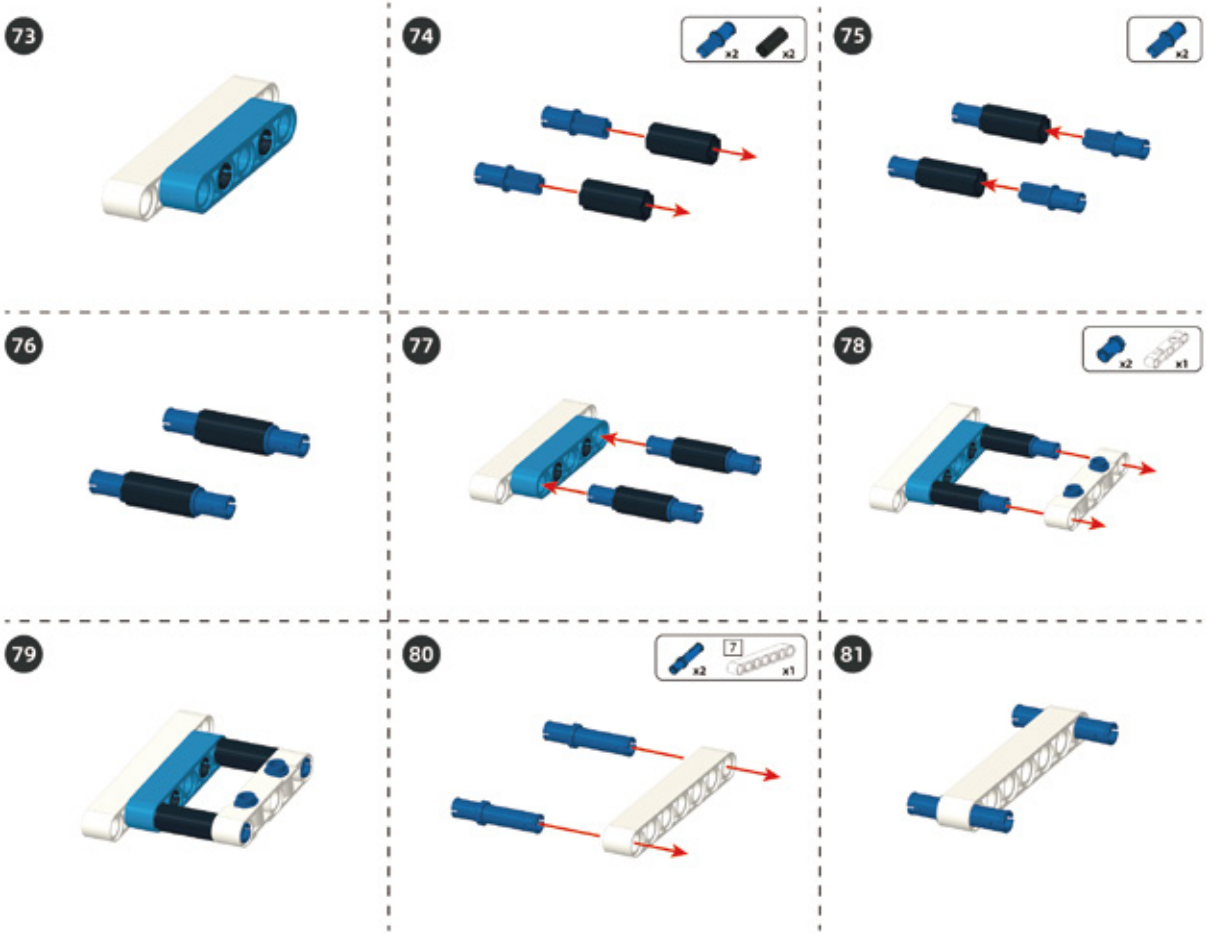
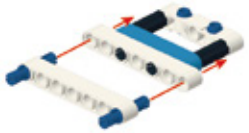



73
74
x2
x2
75
x2
76
77
78
x2
x1
79
80
7
x2
x1
81

82



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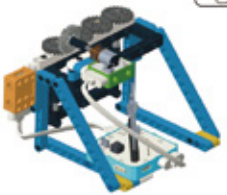
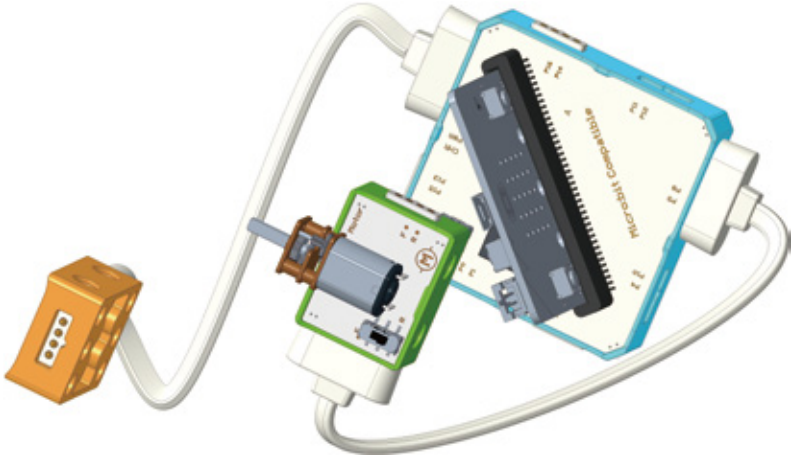


89

90

• Circuit Connection

Connect them according to following circuit diagram.

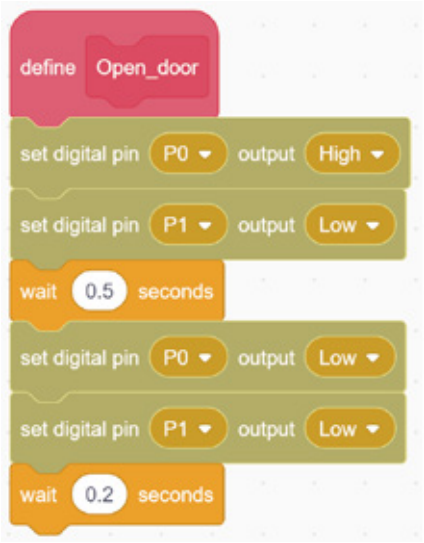


5. Task to Practice

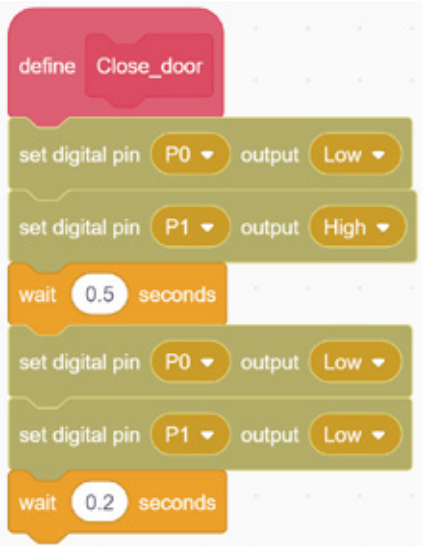
Task Goal: Close and open the door under the control of gesture sensor. Wave your hand to the left to open the door, and wave your hand to the right to close the door.

Task Analysis:

First, define custom block "Open_door"

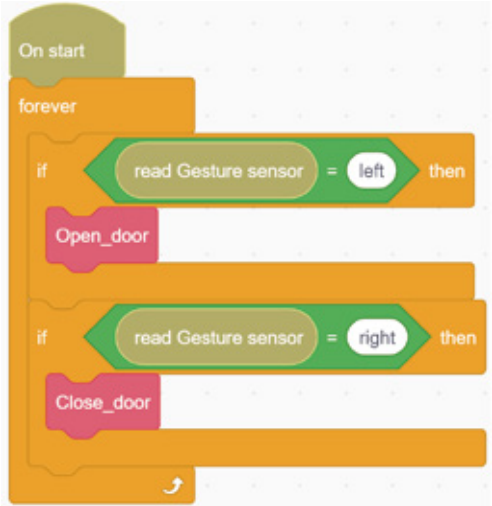


Second, define custom block "Close_door"



Please observe the motor rotation direction, rotating in counterclockwise direction means open, rotating in clockwise means closed. Meanwhile, it is necessary to adjust the motor's rotation time in both clockwise and counterclockwise direction based on the actual situation, to ensure the door could just open and close.

Third, check gesture senor's direction in the main program.



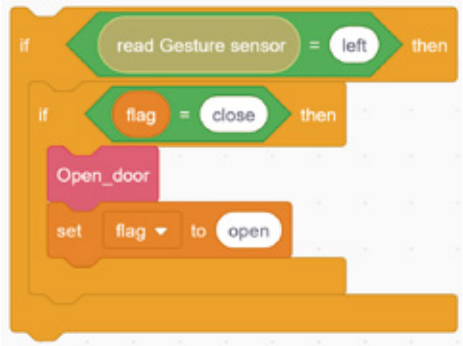
The door would open if it senses the gesture to left, it would close if it senses the gesture to right.

Please note that the motor will still rotating when you wave hand many times in the same direction, which would damage gears. Therefore, we need to add a restriction condition: when the door is open, motor will not rotate clockwise under the influence of gesture. On the contrary, motor will not rotate counterclockwise under the influence of gesture when door is closed.

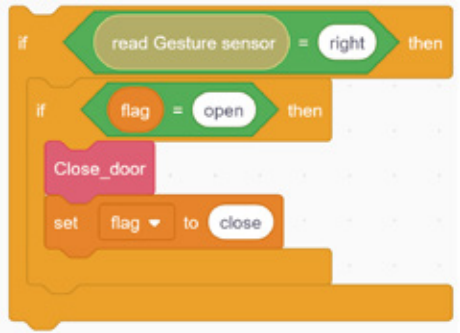
Solution: Sets a state variable and assign two different values, one indicates "open the door", the other means "close the door".

For example, we could set a variable "flag" and assign an initial value of "close", which means it is closed now.

We need to check if the value of variable "flag" is equal to "close" before opening the door, it would open the door only when this condition is satisfied; reset the value of "flag" to "open" after opening the door, which means it is open now.



Similarly, you need to do the same thing before closing the door and reset the value of “flag” to “close” after closing the door.



Now let’s try the completed program! Download the program to the main console and try different gestures to see how the door works! Want to know how to program to realize it? Try different gestures on your own!

For the complete program, please visit the official website to download: forum.elecrow.com.

6. Game Interactions

Let's invite your friends to experience the game "Free the hostages".

We need to build a little man with structure before playing this game.

After building the little man, put it in the door first, and then close the door, then close the door. Next, let your friend modify the program secretly, mainly modify the gesture used to control the door. Another friend tried to "free the hostage" by guessing the gesture of opening the door. Let's see who could save the hostage in the shortest time.

7. Brainstorming

In the project "Automatic door", we use the gesture sensor module and motor module. In fact, most of the automatic doors in our lives will open automatically when a person approaches, without moving gestures. Let's achieve this based on what we have learned about the IR reflective sensors previously.

Project 6 Line Patrol Car

1. Learning Goals

1. Learning practical application of line patrol robot.
2. Learning working principle of line patrol robot.
3. Master the building and programming of line patrol car.

2. Application

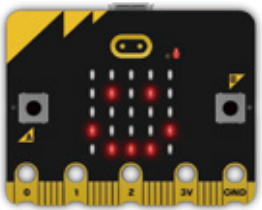
With the development of technology and society, the line patrol robot are used widely in more and more fields. Like in factory, we use line patrol robot to carry and load goods and in restaurant, we use it as waiters to serve food to people. Then do you know how the line patrol robot works? Now, we can start to design a new line patrol car.

3. Supplies List

• **Electronic Supplies:**

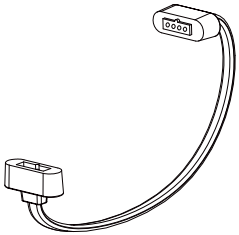
IR Reflective Sensor x2

DC Motor x2



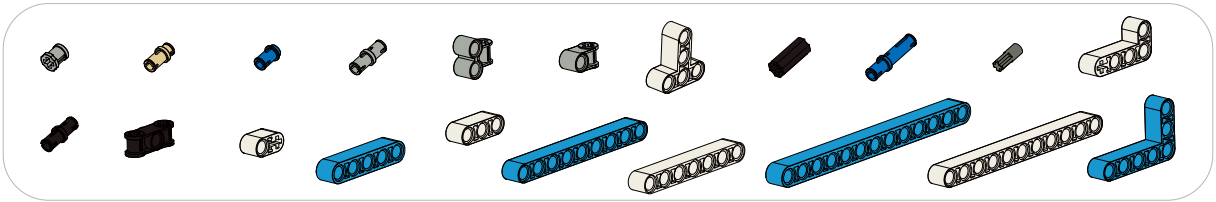
Micro:bit x1

Micro:bit Compatible x1



Magnetic Cable x2

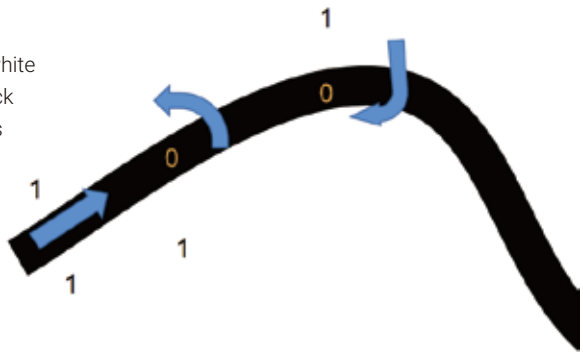
• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



4. Knowledge Analysis

• Working Principle of Line Patrol Robot:

Line patrol robot means the robot will walk along the black path in white road surface. As known that when IR Reflective Sensor faces to black objects in short distance, its will output low level 0, but when it faces to white objects in short distance, its will output high level 1.

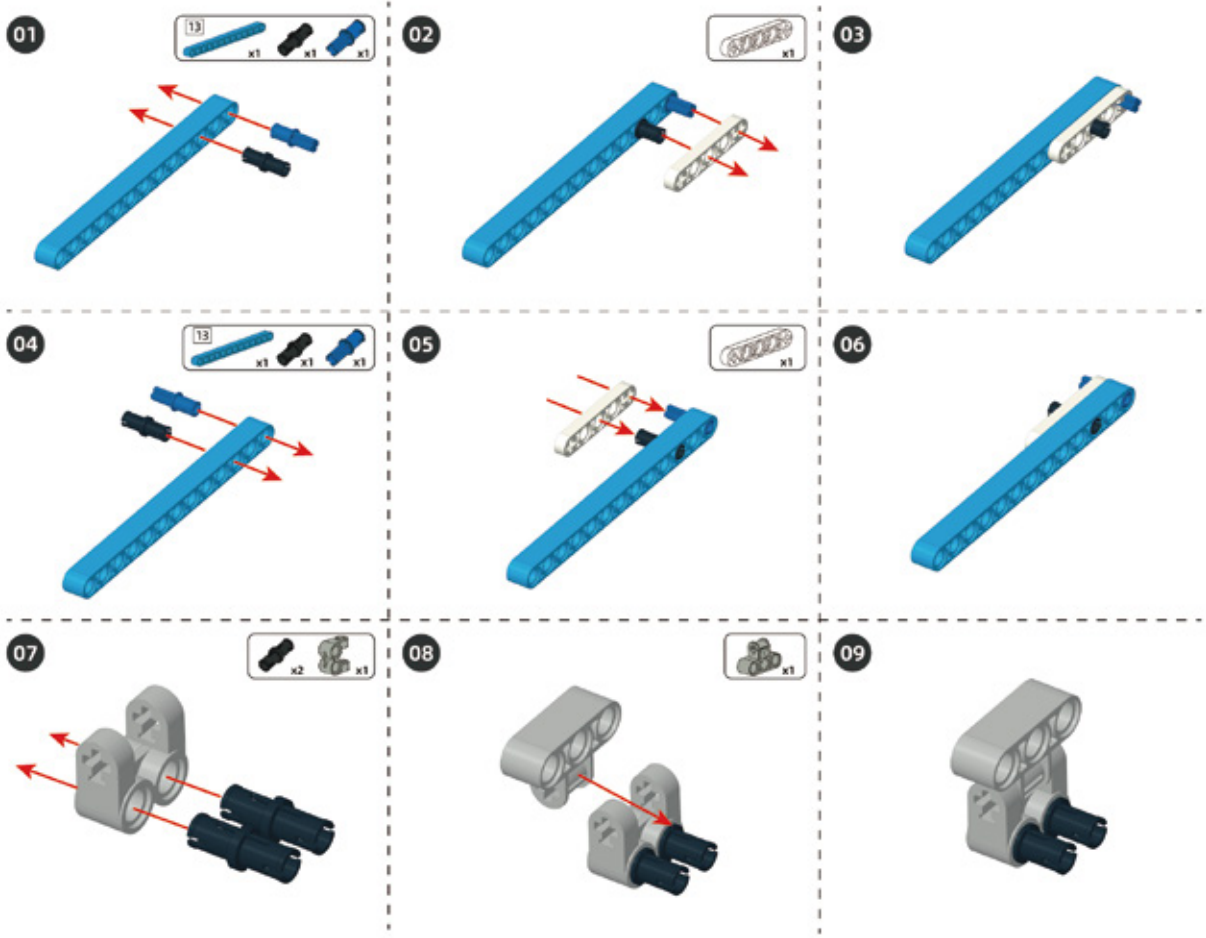


When we use two IR Reflective Sensor side-by-side to do line patrol, three situations will happen:

Situation Analyse	Signal From Left Sensor	Signal From Right Sensor	Relative Location of Sensor and Black Path	Line Patrol Amendment
Situation1	1	1	Center (the black path in center of two sensors)	Moving Forward
Situation2	0	1	Deviation to the right(Left sensor is on black path)	Turning Left
Situation3	1	0	Deviation to the left(Right sensor is on black path)	Turning Right

5. Model Building

• Structure Building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x1
x1
x1
02
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05
x1
06
07
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x1
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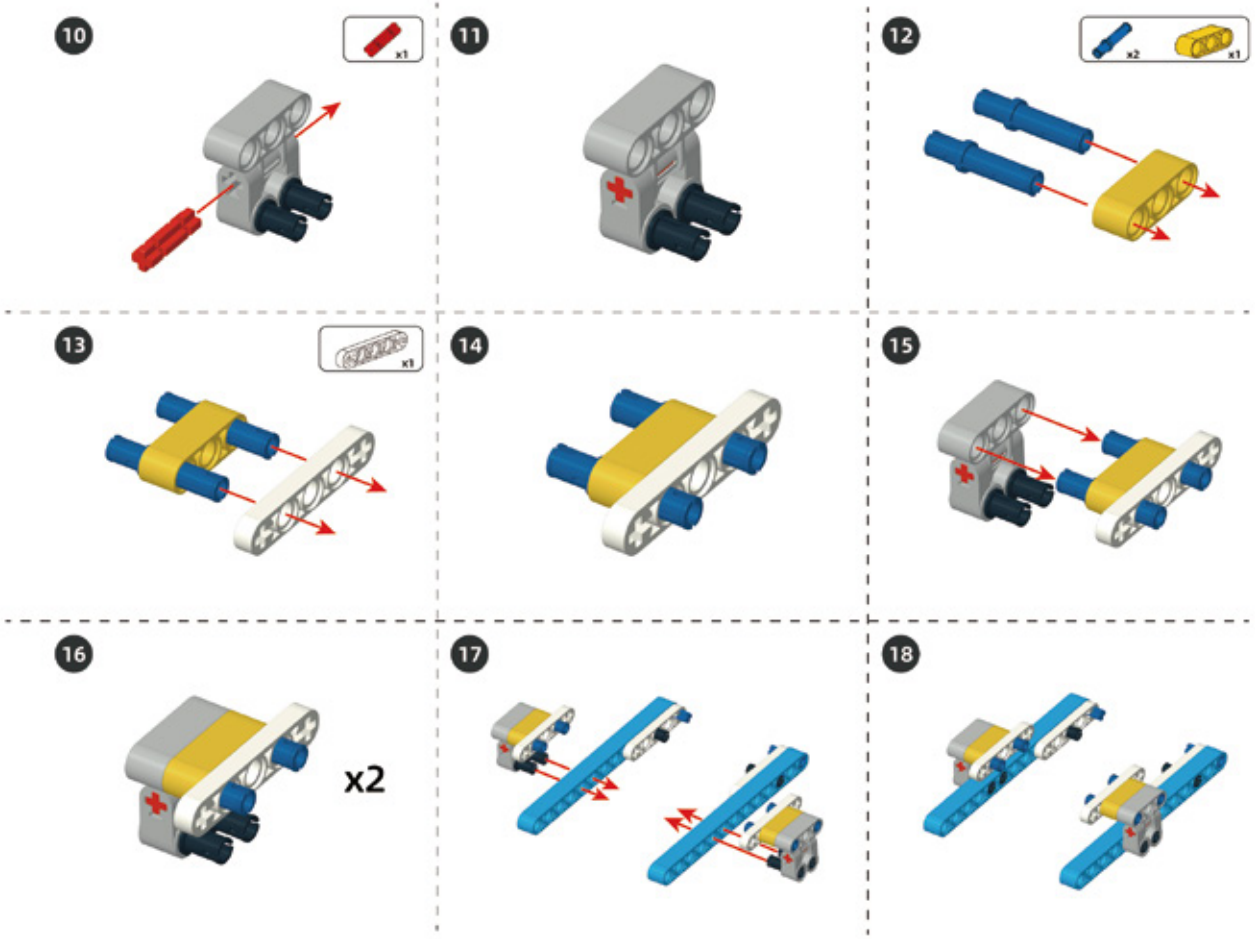
x1
09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x1
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x1
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x2
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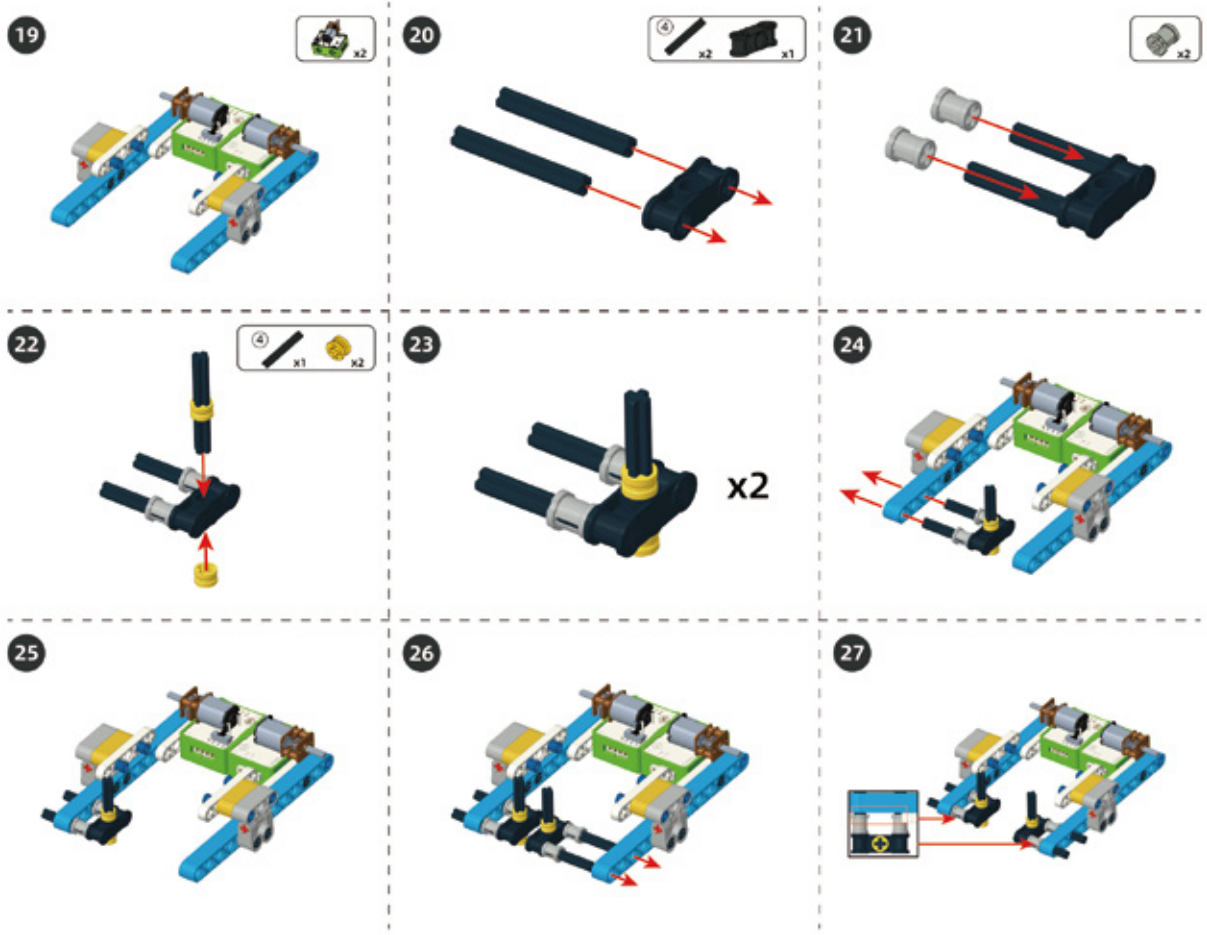
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x2
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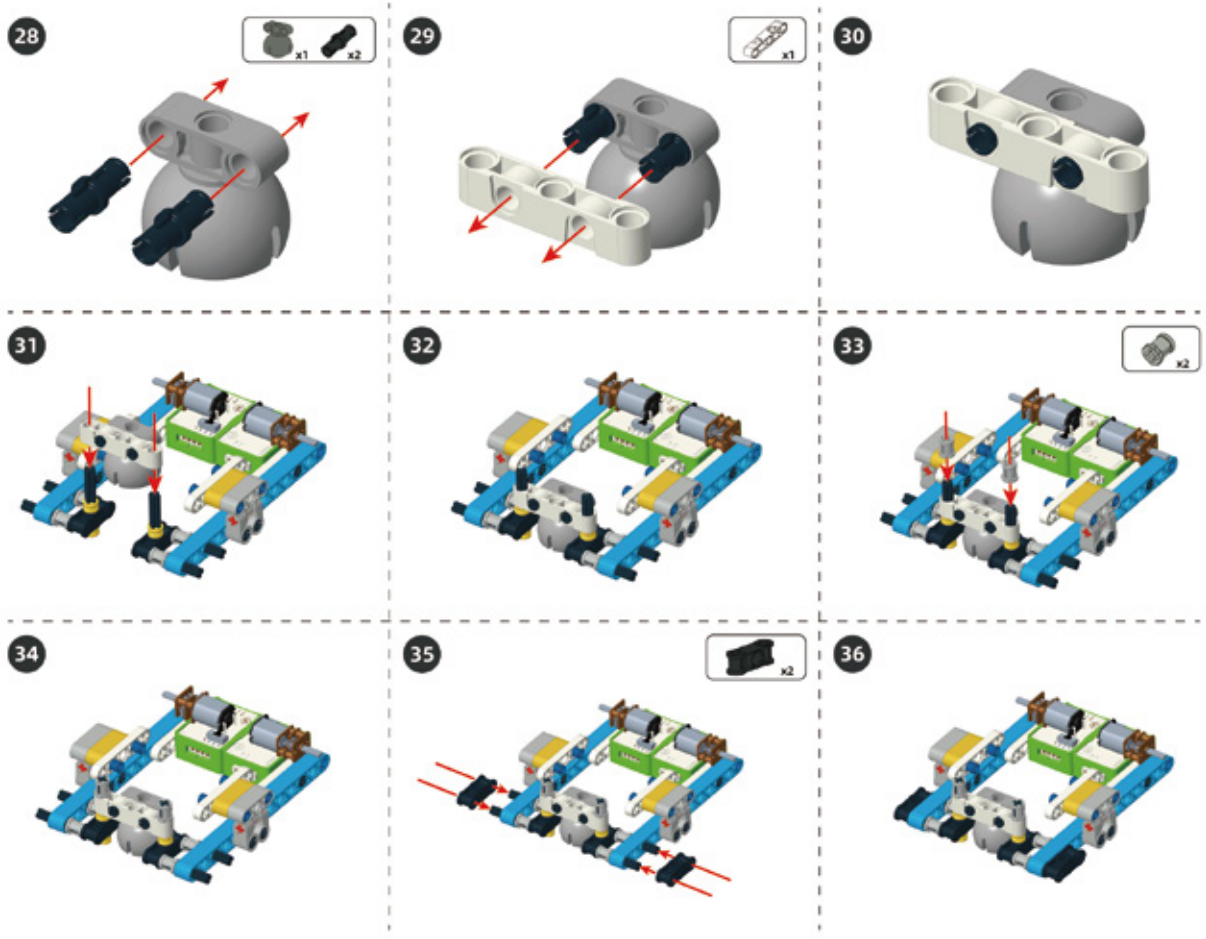
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x2
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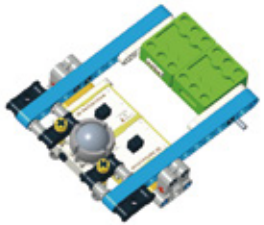
x2
36

37

38



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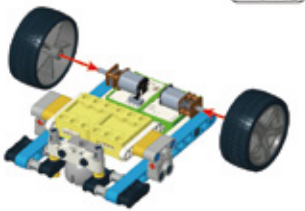

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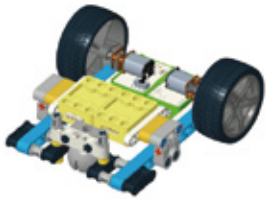

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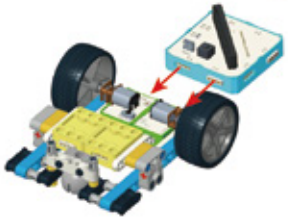

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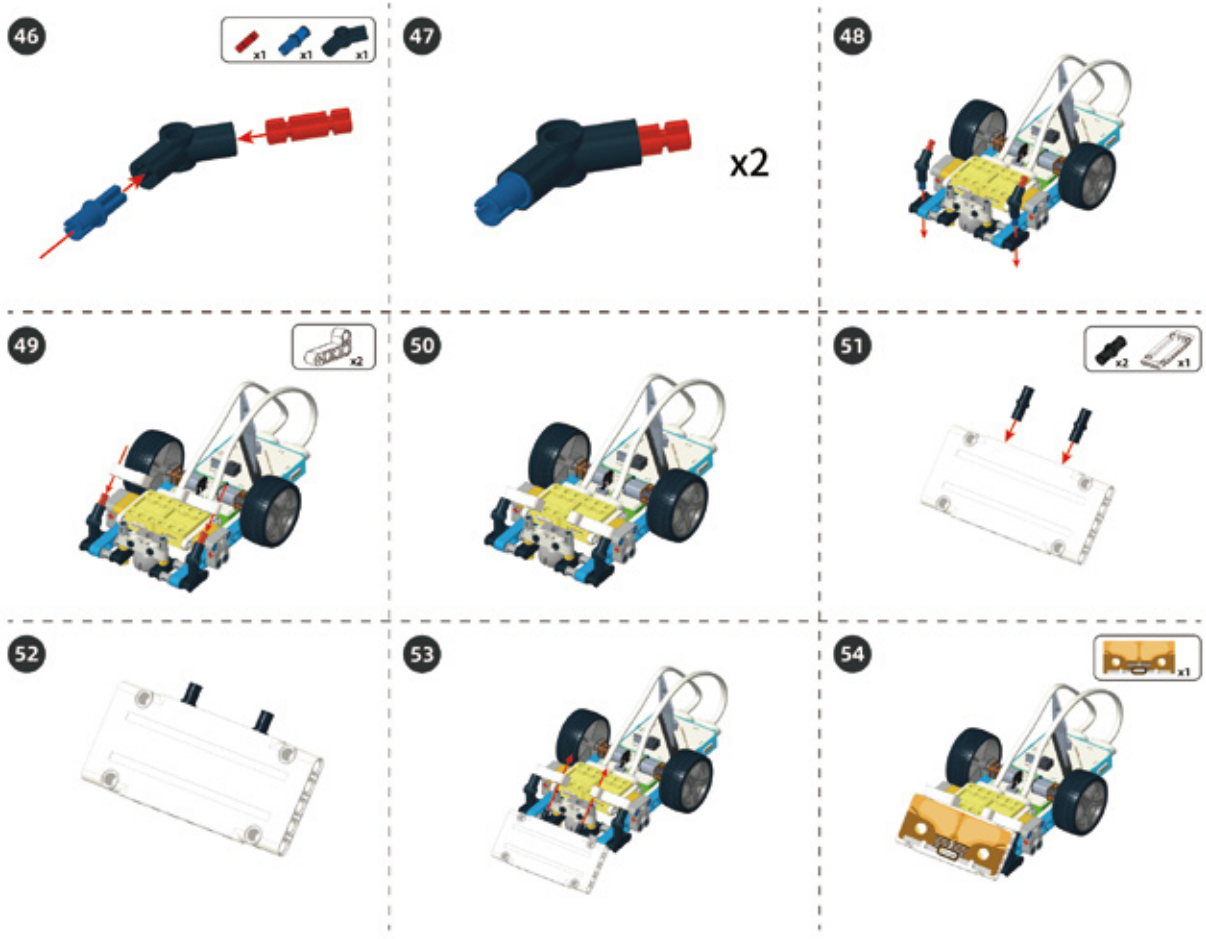
46
x1
x1
x1
47
x2
48
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x2
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51
x2
x1
52
53
54
x1

• Circuit Connection

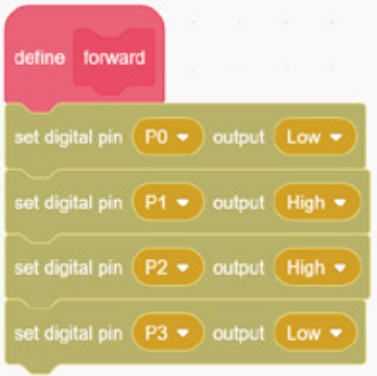
Connect the circuit according to following diagram.

6. Task to Practice

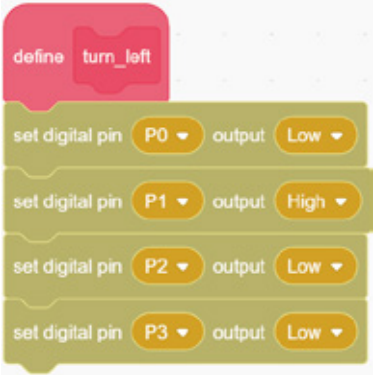
Task Goal: Moving forward along the black path on the map.

Task Analysis: To achieve our goal, first we should connect left motor of line patrol car to port P0 and P1, and connect right motor to port P2 and P3. Then connect left IR Reflective sensor to port P12, right IR sensor to port P14. Here is the step of programming:

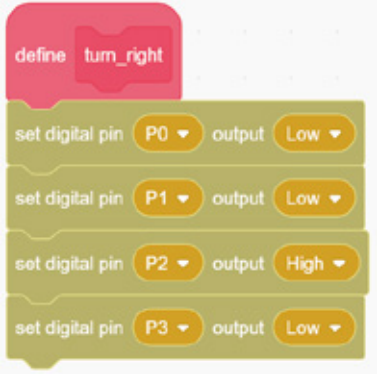
Firstly, defining the custom block of forward;



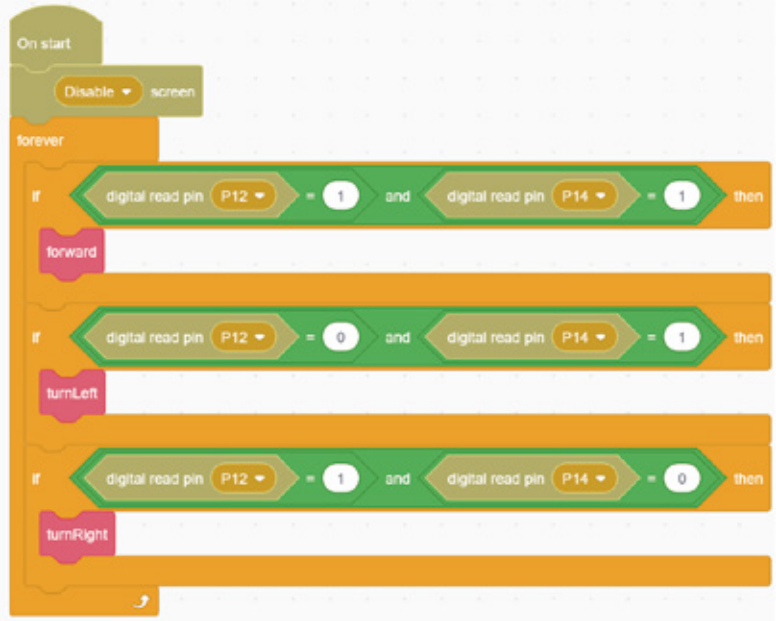
Secondly, defining the custom block of turn_left;



Thirdly, defining the custom block of turn_right;



And then according to the situation analyze, here is our system judgment.



Three situations will occur during the patrol. For each situation, the car will do different actions to ensure the success of the entire patrol.

Extended Task: Now, the car can complete the line patrol, but if we want to stop it, what can we do? Will there be any changes to the map?

For the complete program, please visit the official website to download: forum.elecrow.com.

7. Game Interactions

Invite your partners to have the competition of line patrol carrying!

Game Rules: Take the waste paper or some light objects to be the goods and using black tape or black pen to make a path for the game. Programming to make the car carry the goods and start line patrol from location A to location B and back to A in circulation. Let's compete whose program can make the car finish the game successfully.

8. Brainstorming

In this lesson, we learned how to use two IR reflective sensors to make the robot patrol. But in practical applications, we may encounter such a situation, such as walking people or other things in front of the robot. Let go of your thoughts and think about whether you can add ultrasonic ranging sensors for patrol cars to achieve patrol and obstacle avoidance functions at the same time.

Project 7 Elevator

1. Learning Goals

1. Know the working principle of elevator.
2. Learn the logic to design complex programs.
3. Complete the building and programming of elevator.

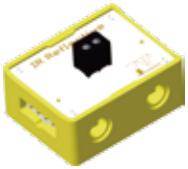
2. Application

Elevators are indispensable vertical transportation equipment for high-rise buildings such as residences, office buildings, supermarkets, factories, and so on. The invention of the elevator not only makes life convenient but also greatly saves space resources.

Do you know how the elevator works? Next, let's learn the secrets of elevators through building the structure and programming!

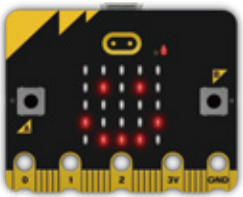
3. Supplies List

• **Electronic Supplies:**



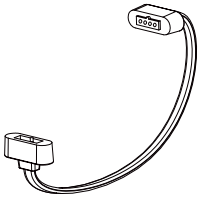
IR Reflective Sensor x1

DC Motor x1



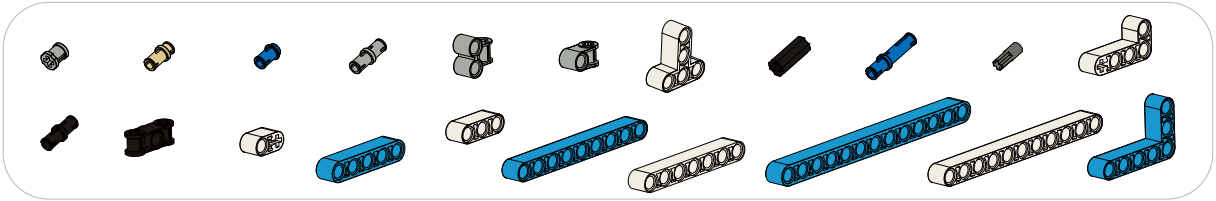
Micro:bit x1

Micro:bit Compatible x1



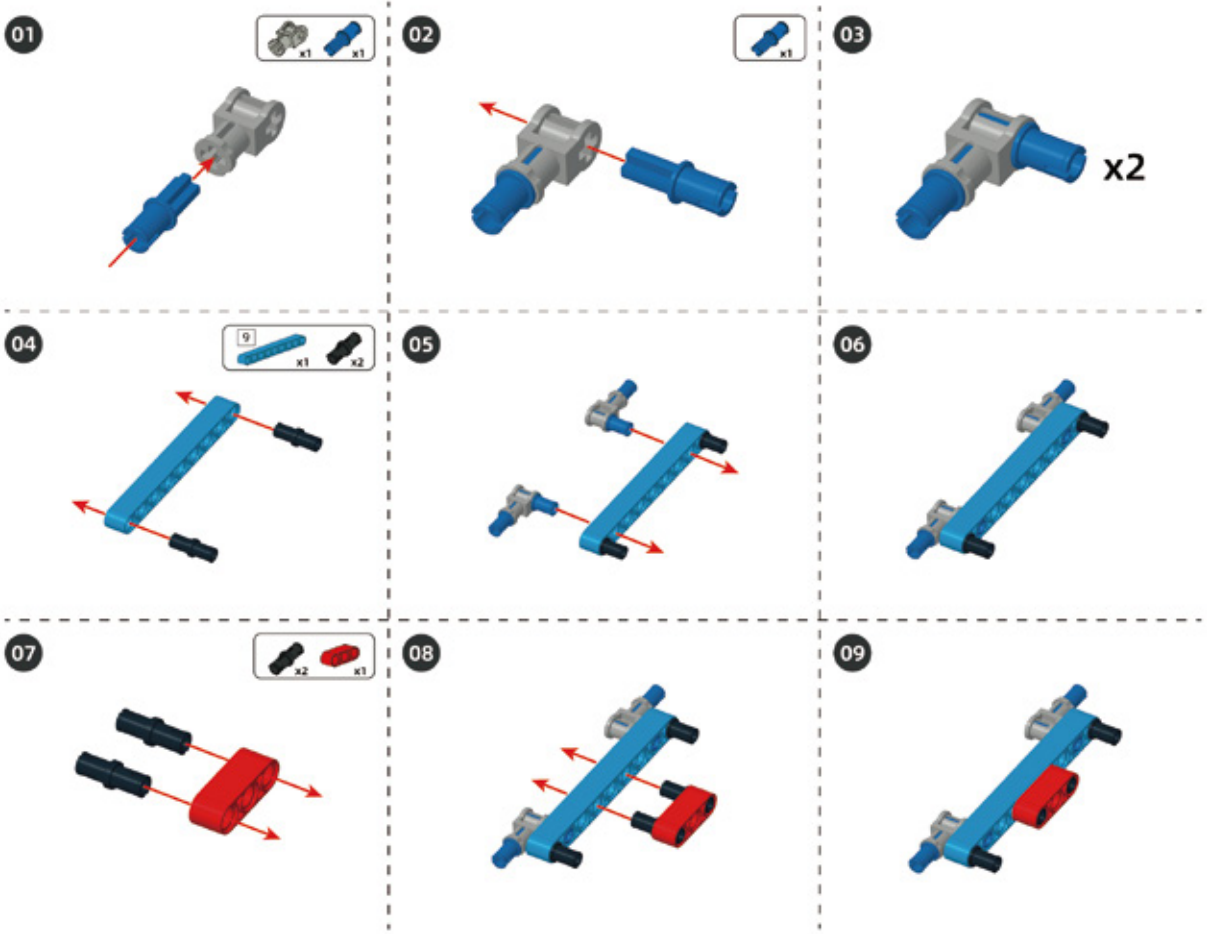
Magnetic Cable x2

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



4. Model Building

• **Structure Building**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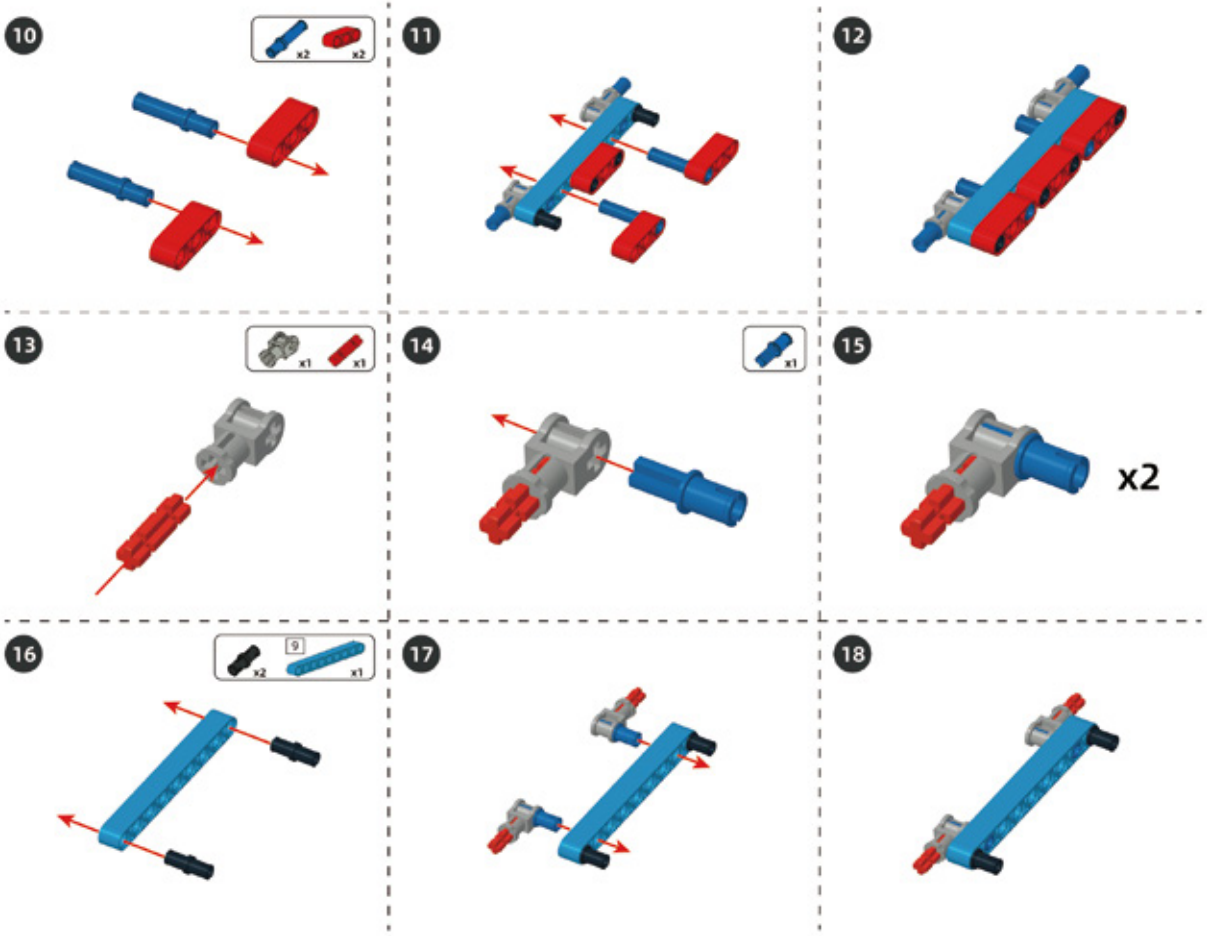
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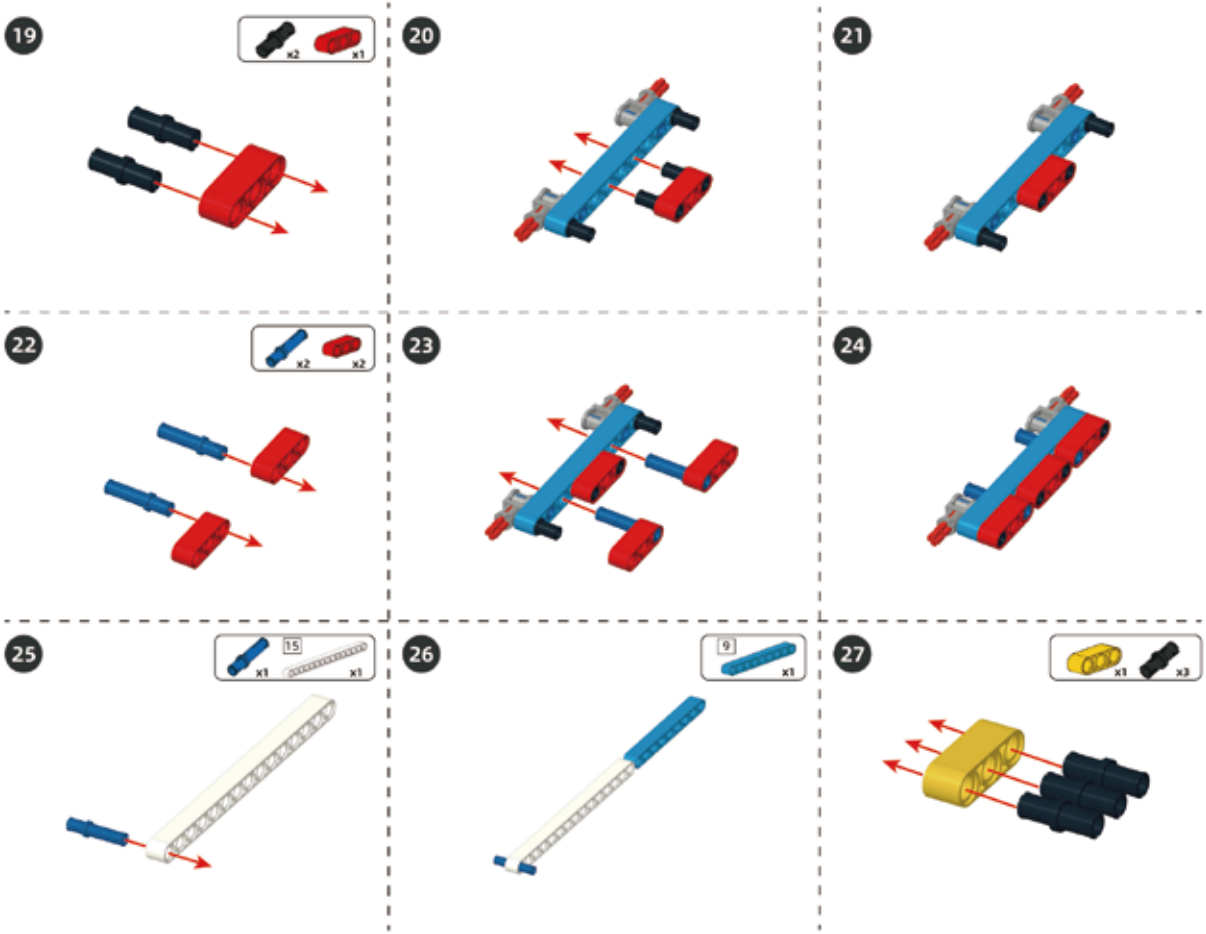
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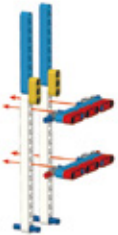

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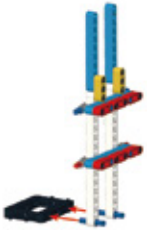

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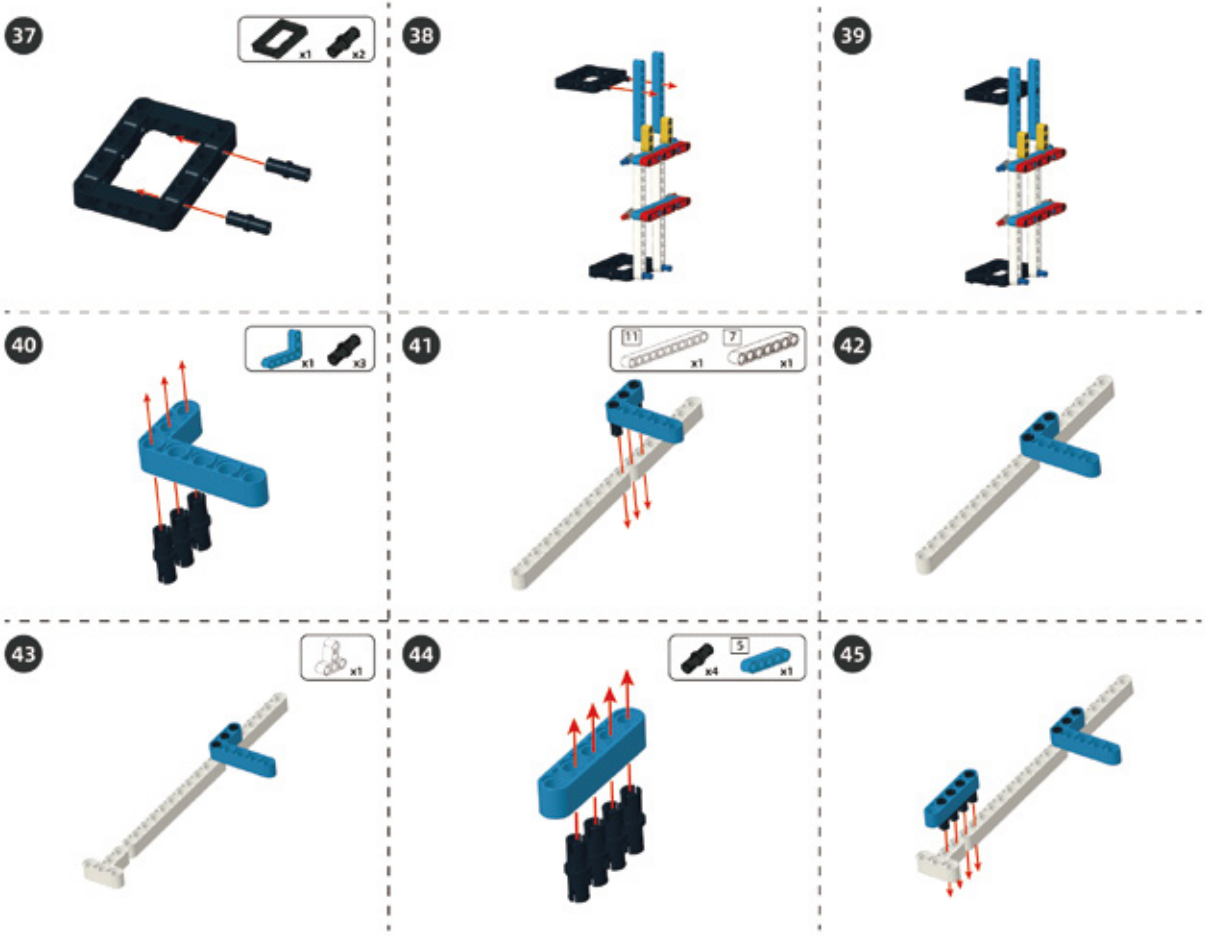
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x4
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x1
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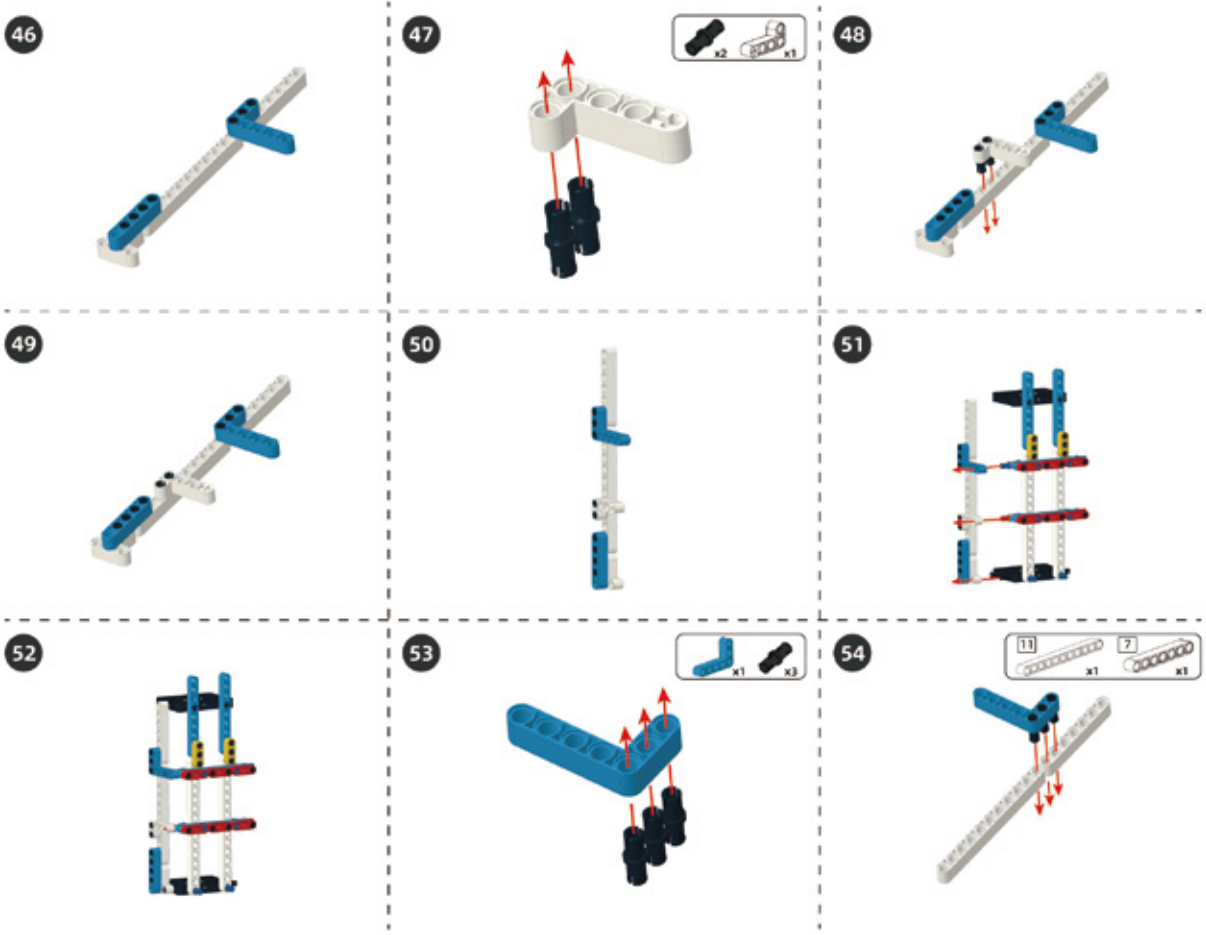
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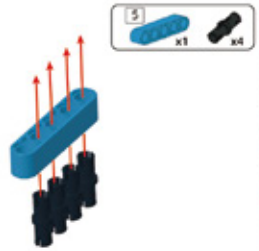

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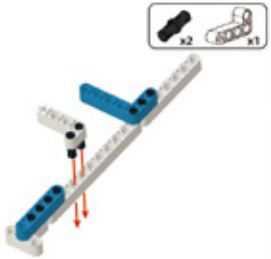

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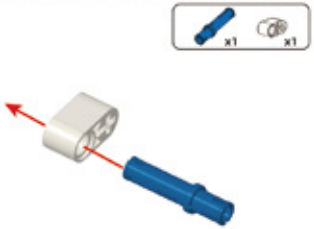

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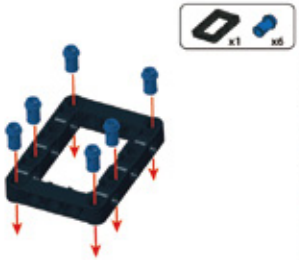

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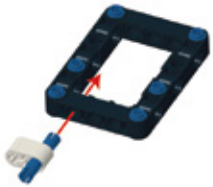

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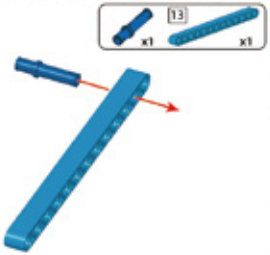

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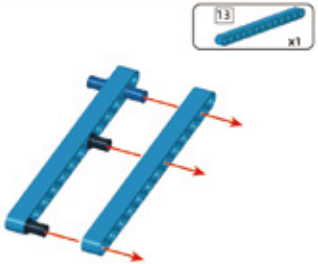

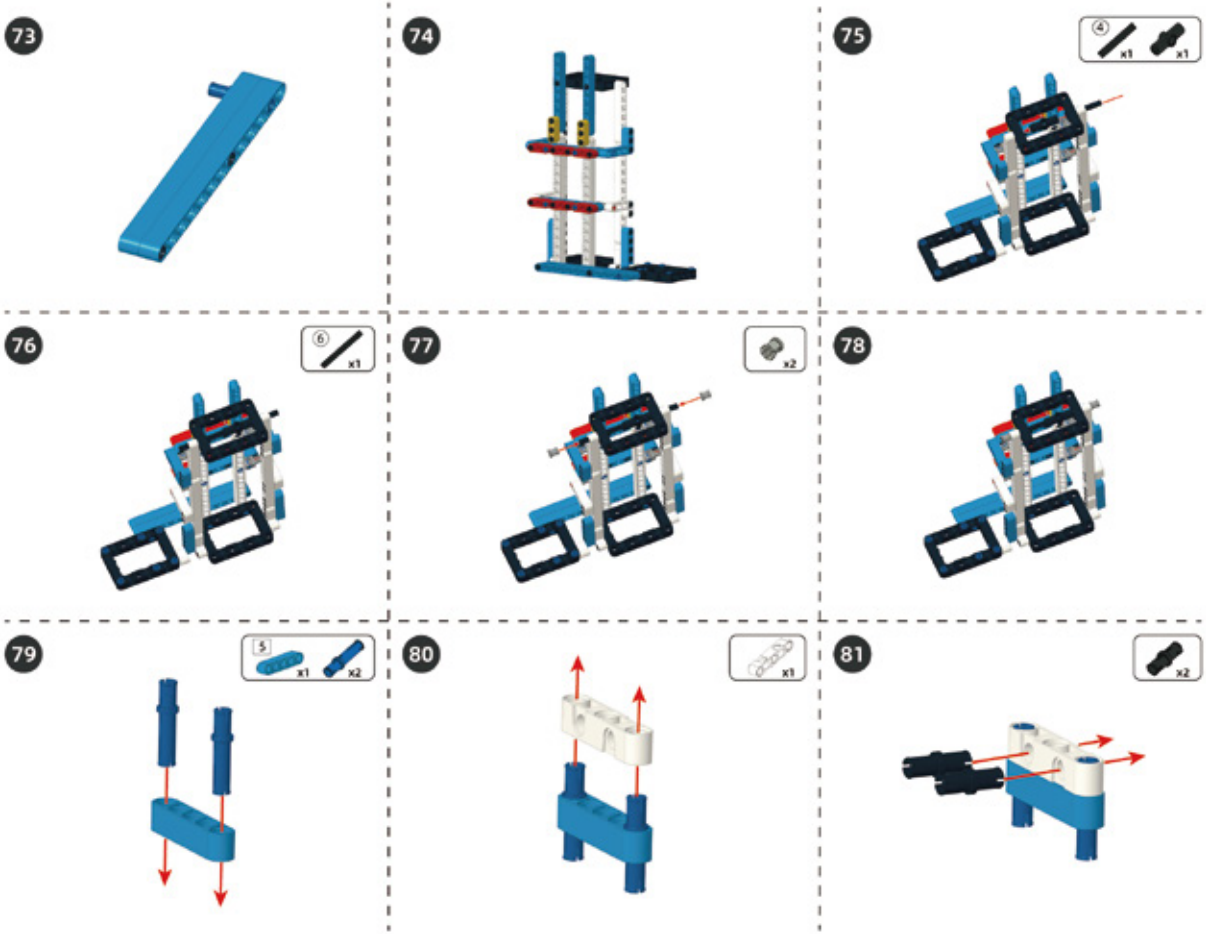
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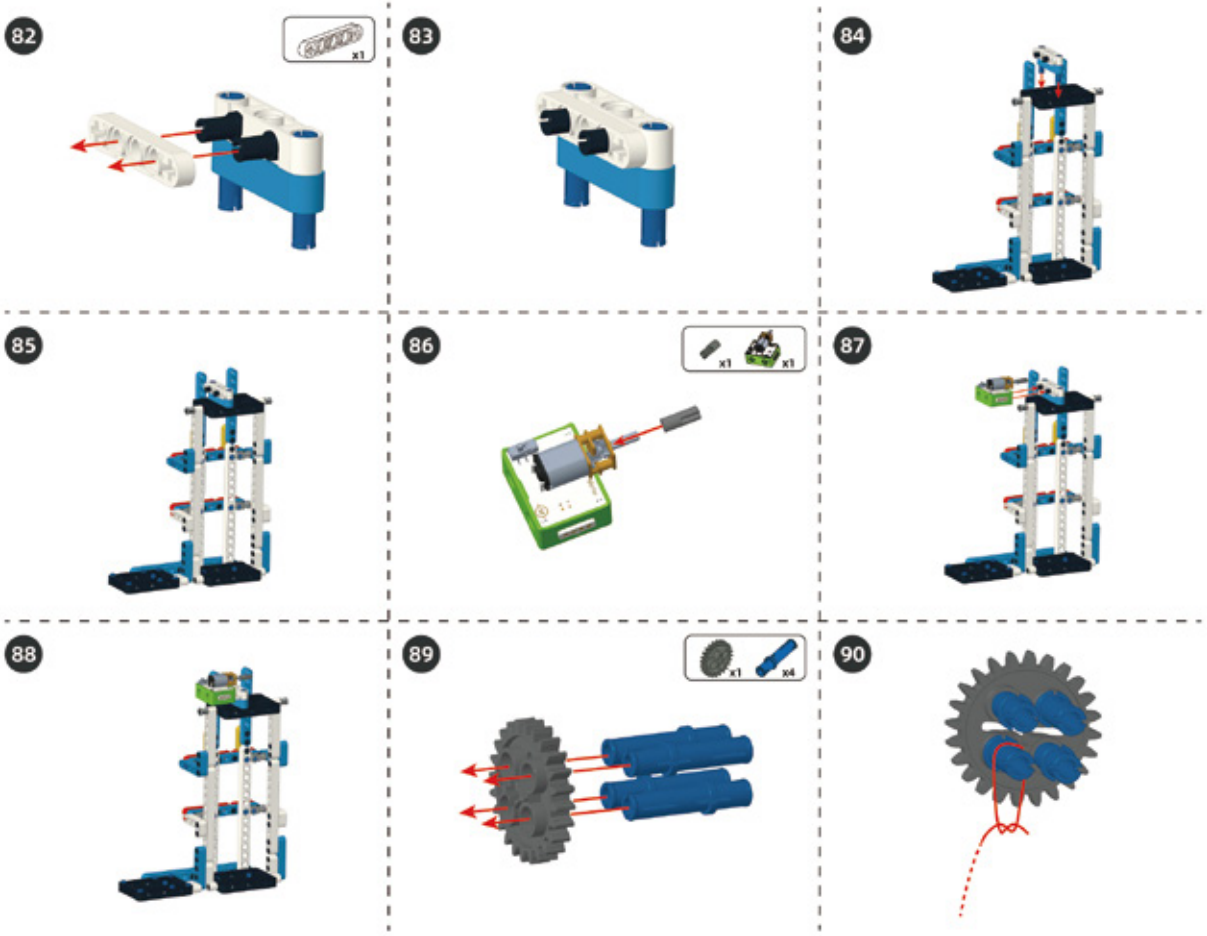
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x1
x4
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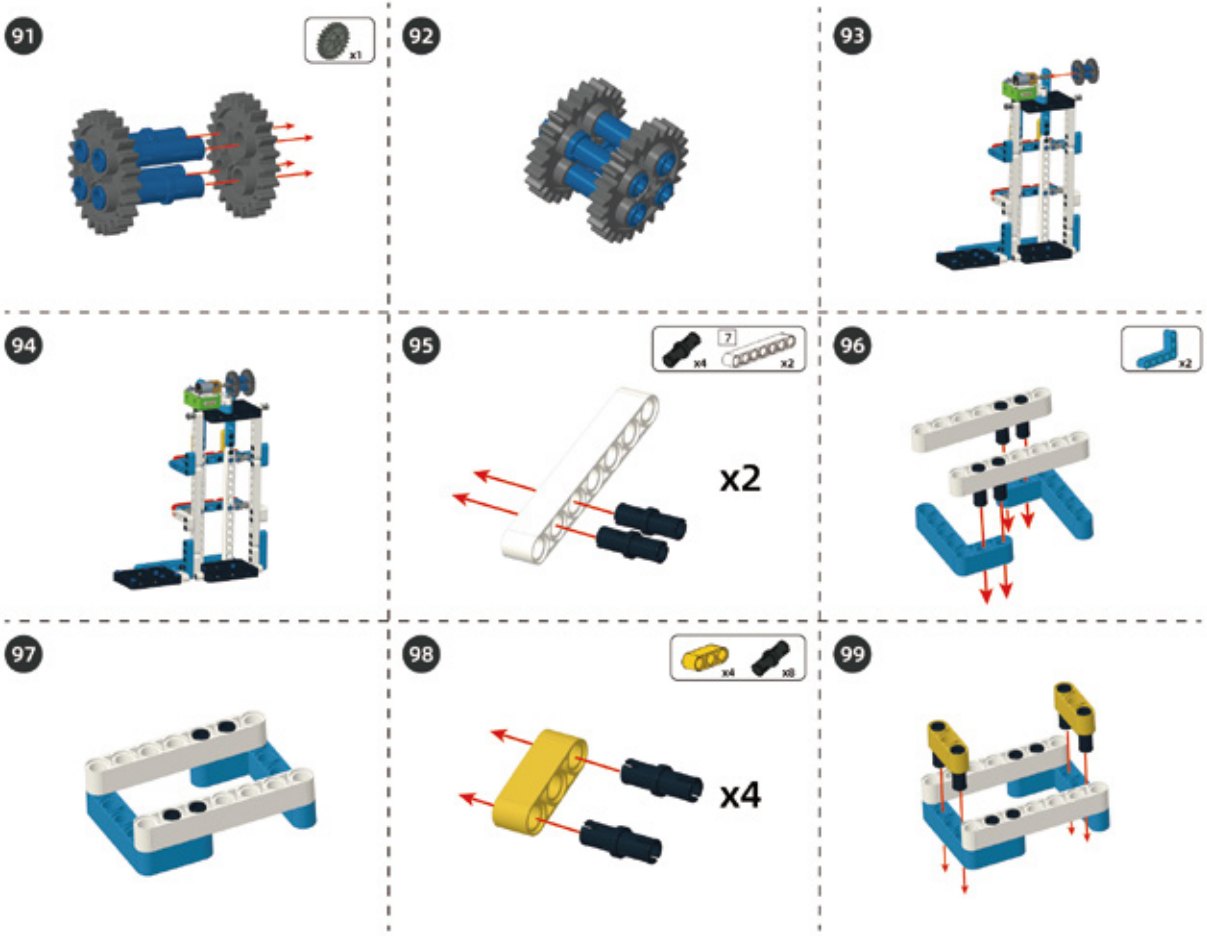
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x2
x2
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x2
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x4
x8
x4
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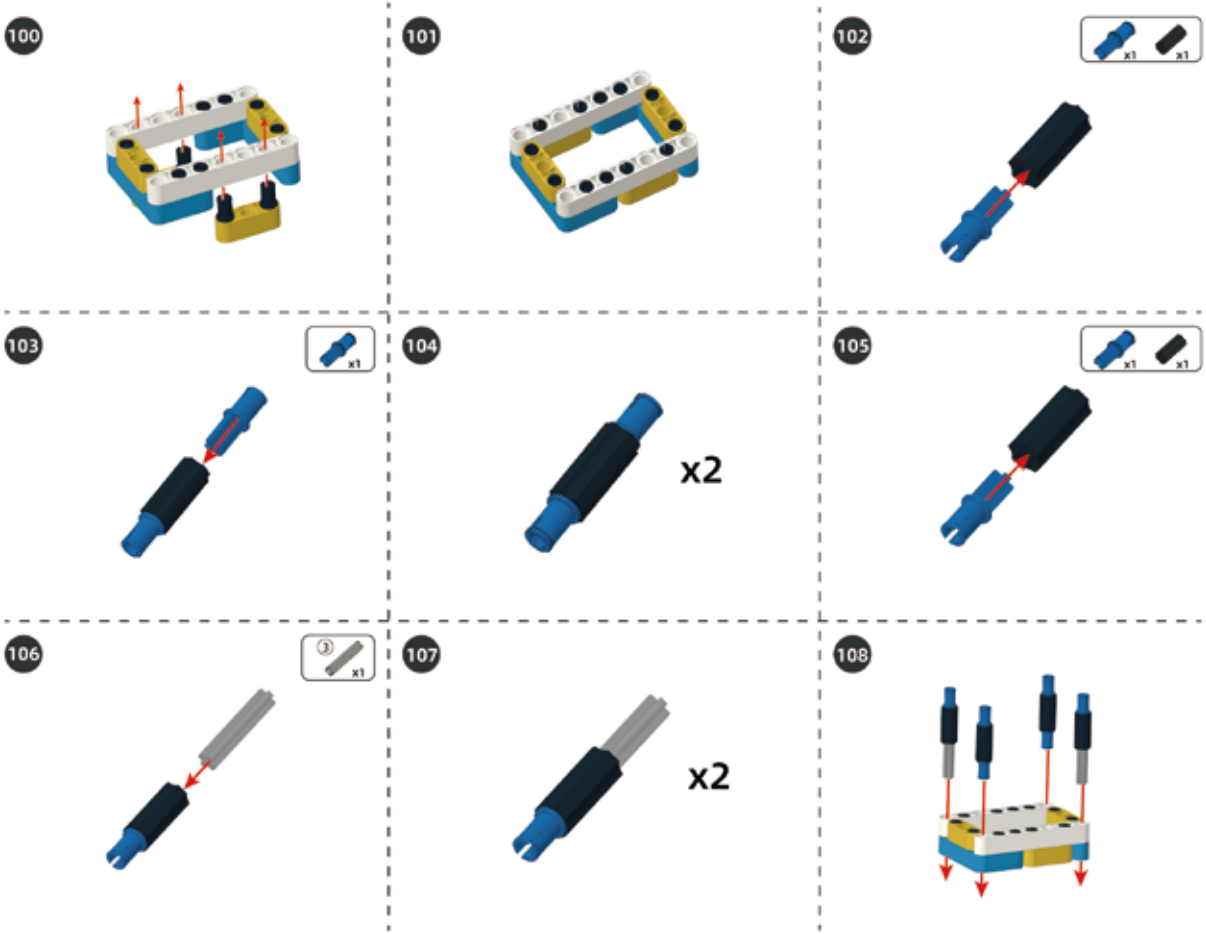
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x2
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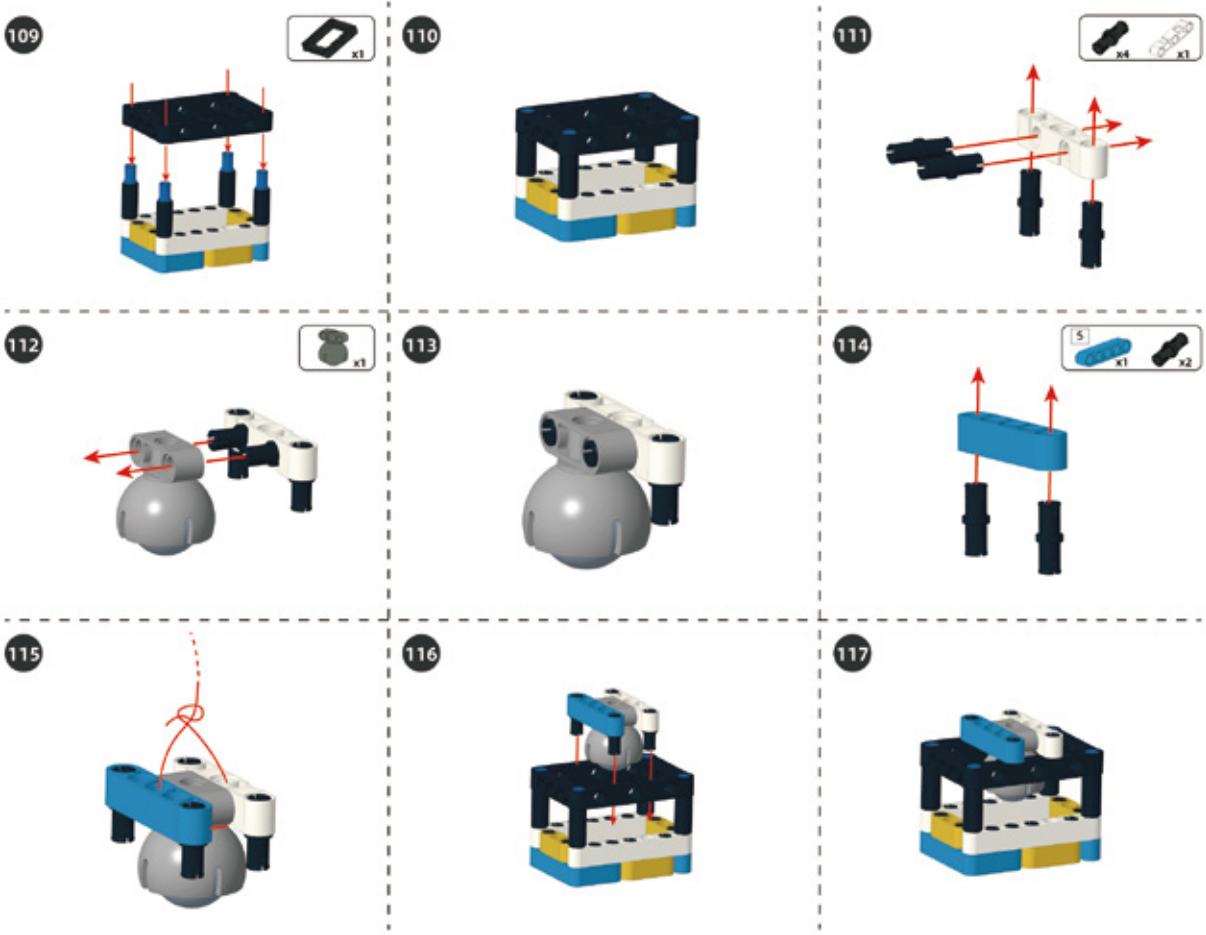
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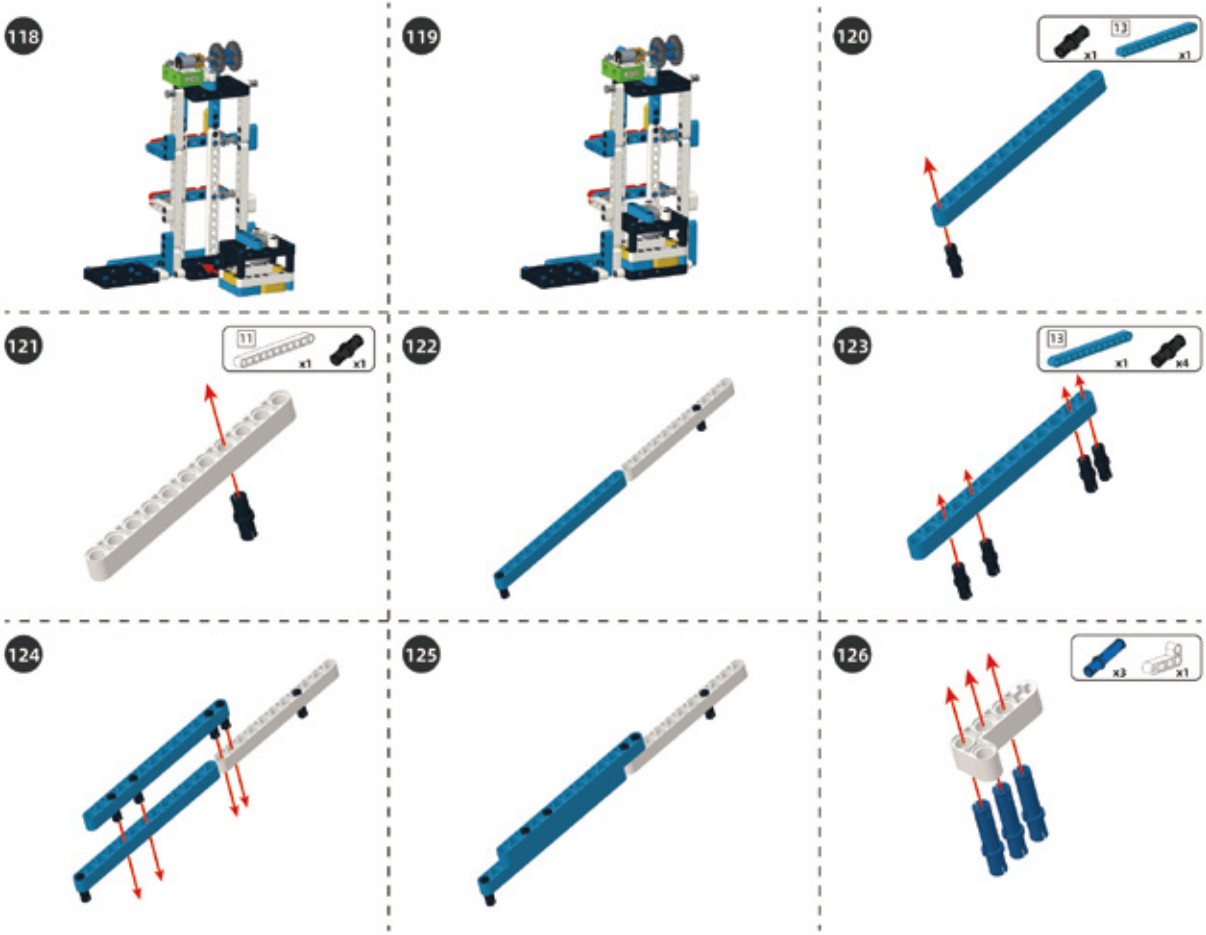
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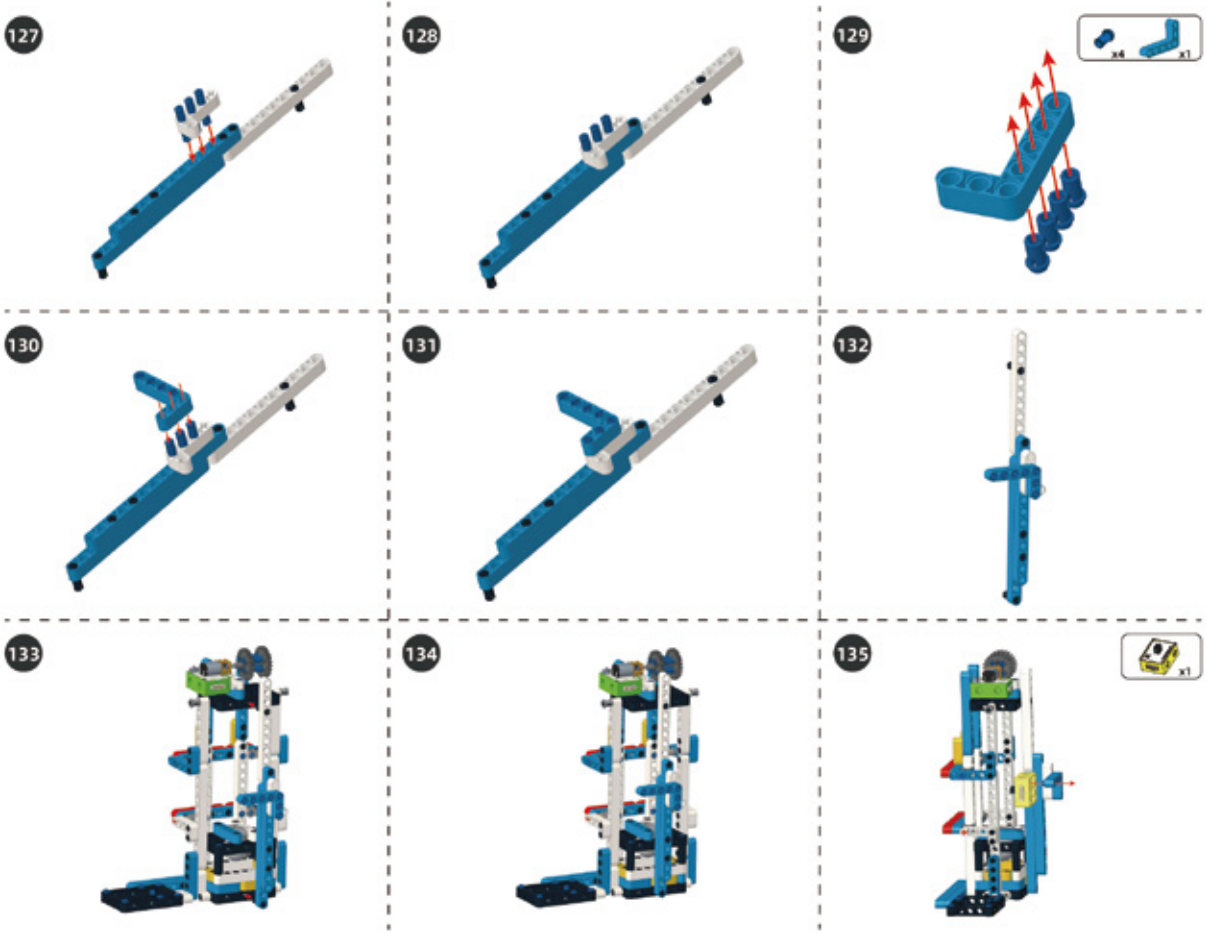
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x4
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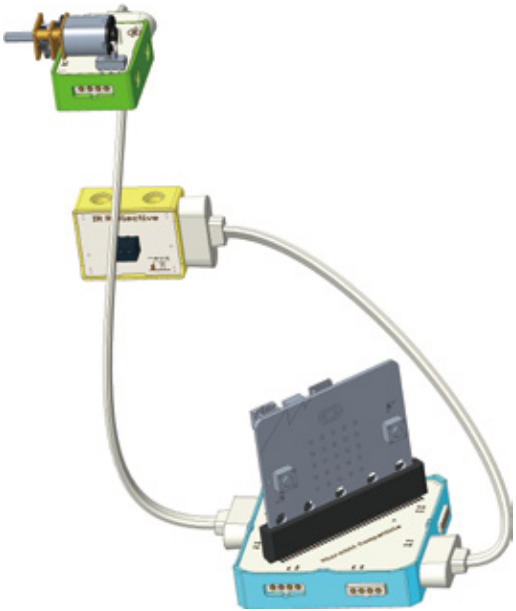
• **Circuit Connection**

Connect the circuits as shown below:



5. Task to Practice

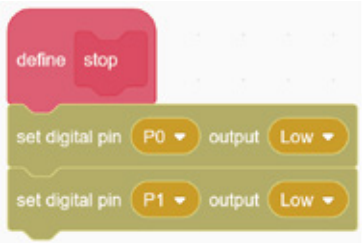
Task Goal: When pressing the button A, the elevator goes to the 1st floor; pressing the button B to the 2nd floor; pressing the button A and button B at the same time to the 3rd floor.

Task Analysis: According to the operation of the elevator, there are three situations for the three key modes on different floors:

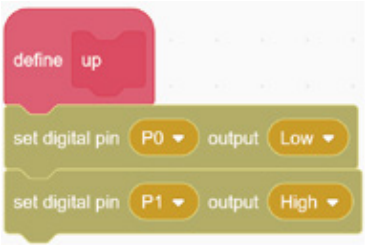
Elevator Status	Press A	Press B	Press A+B
on the 1st floor	**Keep Still**	Rise one floor	Rise two floor
on the 2nd floor	Down one floor	**Keep Still**	Rise one floor
on the 3rd floor	Down two floor	Down one floor	**Keep Still**

Firstly, you can define the blocks of up, down, stop, and init, so that we can call them conveniently.

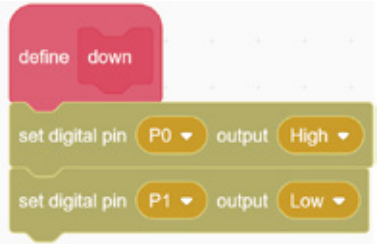
1. Stop;



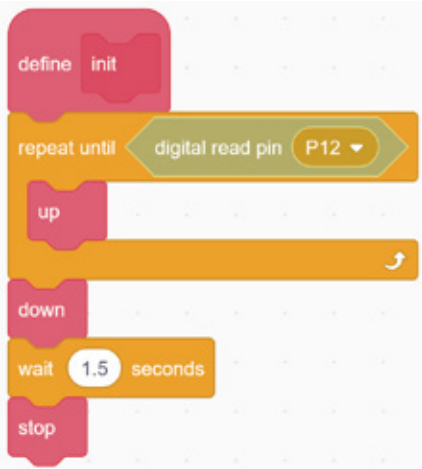
2. Up;



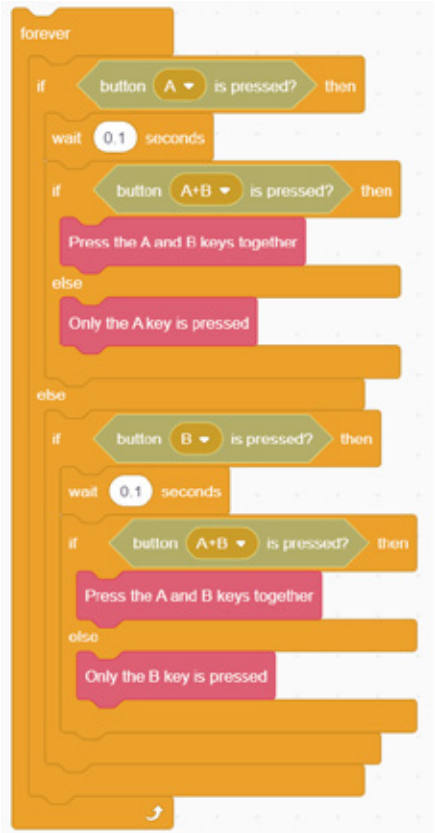
3. Down;



4. Initialize: The elevator box needs to be placed on the first floor manually, and should be lower than the IR reflective sensor, that is, below the second floor. After turning on, the elevator box moves upwards until the IR reflective sensor is triggered, which indicates that it has reached the second floor. And then, the elevator box goes down directly for 1.5 seconds and stops to the first floor. This will help us complete the adjustment of initial position.



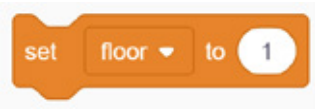
Next, we need to write the corresponding program according to the analysis in the above table. Let's take a look at the general framework of the program firstly:



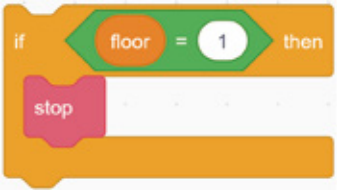
In order to avoid that the A+B key cannot be pressed accurately at the same time, it is judged again whether the two keys are pressed at the same time by delaying 0.1 seconds when pressing button A or button B respectively. There are four judgment situations above, among which A+B pressed are twice, but it's the same situation.

Then we need to write the program according to the button condition and the current position of the elevator. Now let's take the case of pressing button A as an example.

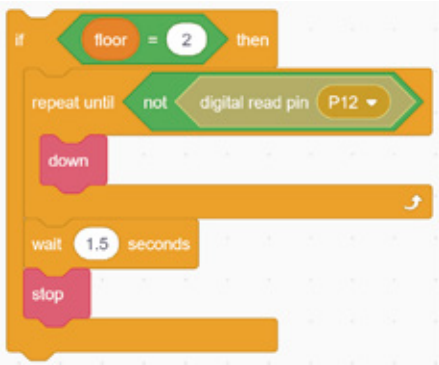
Firstly, we set a variable to record the floor where the elevator is currently located.

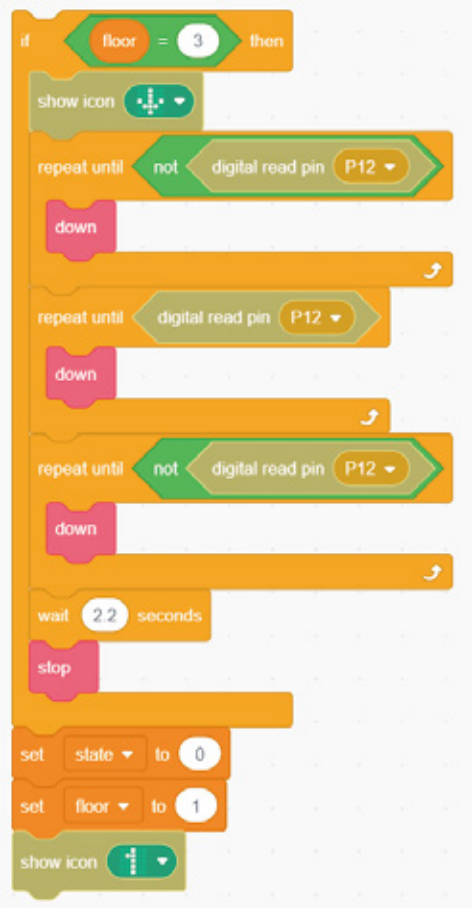


Then judge which floor the elevator on.
Press A, if the elevator box is just on the first floor, then the elevator keeps still;



Press A, if the elevator box is on the 2nd floor, the elevator will go down 1 floor. Since the current position of elevator box still can be detected by the IR reflective sensor, the elevator box has to go down to leave the detection range of the IR reflective, and continue to go down for 1.5 seconds (the time depends on the actual situation) and then stops;





Press A, if the elevator box is on the 3rd floor, the elevator needs to go down 2 floors. Due to the elevator box structure is hollow, the elevator box must first go down until the IR reflective sensor detects the object (the lower edge of the elevator) for the first time, and then continue to go down until the IR reflective sensor cannot detect object (that is, at this time, the lower edge of the elevator box is completely outside the detection range of the IR reflective sensor, and it begins to enter the hollow part of the elevator), and then continue to go downwards until the IR reflective sensor detects the object for the second time (the upper edge of the elevator), and finally continue to go down until the upper edge is outside the infrared detection range. At this time, it has reached the second floor, and then go down according to the time from the second floor to the first floor. Finally, set the variable "floor" to 1, and display it on the dot matrix screen.

The other two situations are also written in this way. We're not going to explain it in detail here. Please download the complete program to the mainboard, and carefully observe and analyze whether the execution of each floor is consistent with your thoughts.

For the complete program, please visit the official website to download: forum.elecrow.com.

6. Game Interactions

In many high-end places, there will be dedicated elevator service personnel at the elevator on the first floor. They will ask politely and press the corresponding floor for you.

Now, let's invite your friends for a polite elevator trip!

When finding visitors coming to the elevator, the person standing by the elevator should politely ask and tell the distribution of the relevant floors, and press the corresponding floor for the visitors.

Second floor: coffee shop

Third floor: library

7. Brainstorming

The elevator project uses a motor and an IR Reflective Sensor module, which is complicated from the aspect of structure and program.

In our daily life, the elevators have many other functions, such as a buzzer that will prompt at each floor. You can try to add this feature!

Project 8 Color Sorter

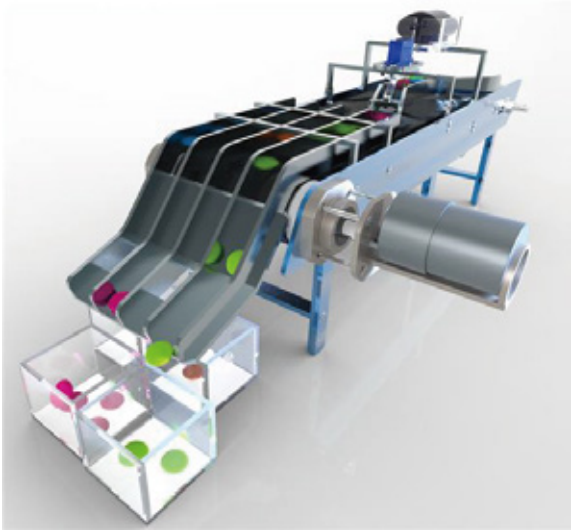
1. Learning Goals

1. Know the application of color recognition technology.
2. Learn how to use color sensor.
3. Complete the building and programming of color sorter.

2. Application

With the advancement of society, in order to liberate hands and improve production efficiency, many smart devices have emerged. Color sorters are one of them. For example, color sorters are used in factories to sort red fruits and cyan fruits. Do you know the principle of color recognition?

Next, let's make a color sorter!

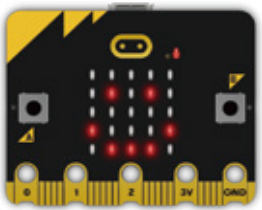


3. Supplies List

• **Electronic Supplies:**

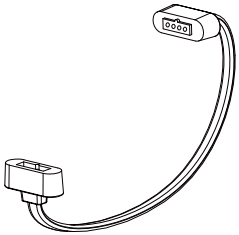
Color Sensor x1

DC Motor x2



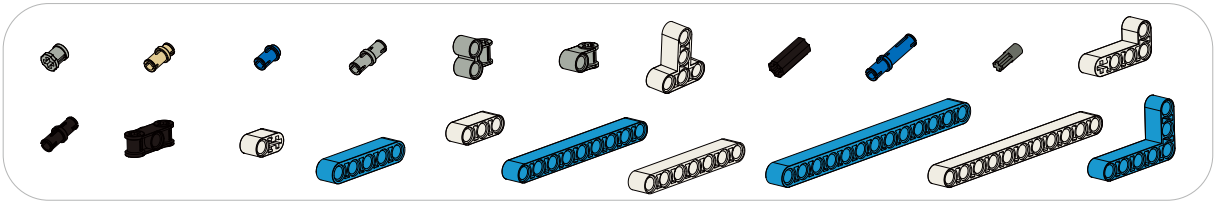
Micro:bit x1

Micro:bit Compatible x1



Magnetic Cable x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



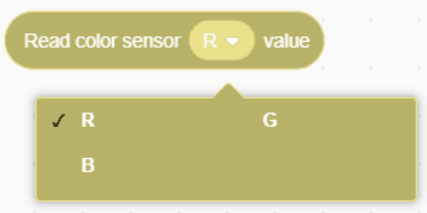
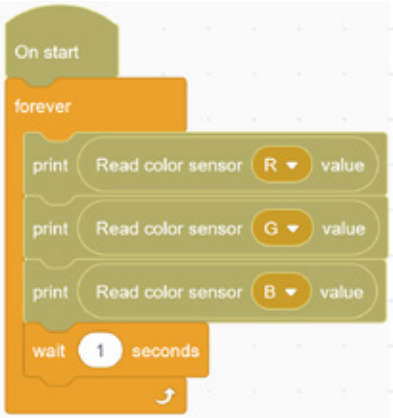
4. Knowledge Analysis

• **Color Sensor:**

1. Color Sensor Module: It is an I2C module that can detect different colors. Each color is superimposed by fixed three primary colors. The value of the three primary colors of R, G, and B can be obtained through the color sensor, and the value range is between 0-255 (R: red, G: green, B: blue). The values of three primary colors of R, G, and B can be used to determine the color. You can check the R, G, B values of different colors on the Internet.

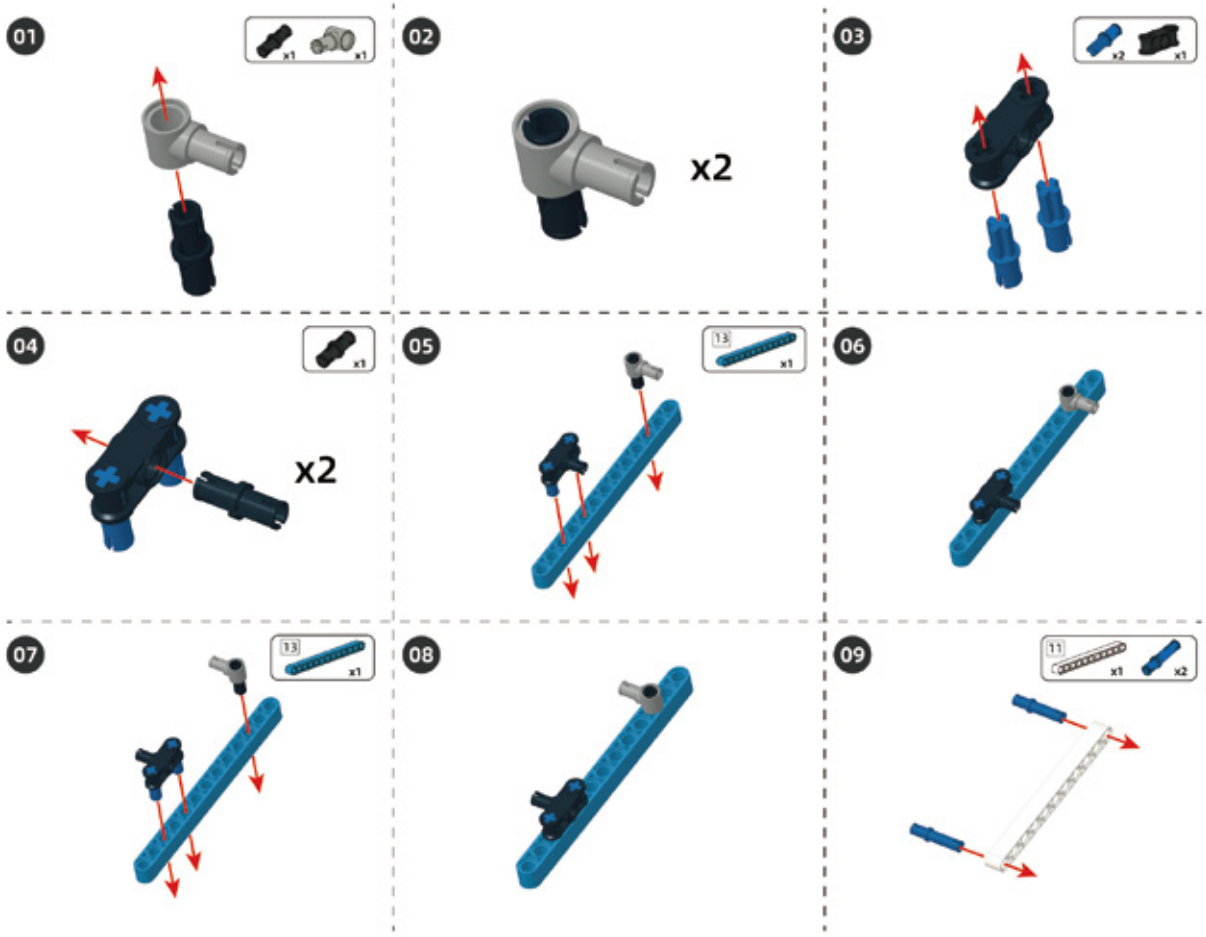
Note: When using the IIC module, you need to connect the module and turn on the power before downloading the program.

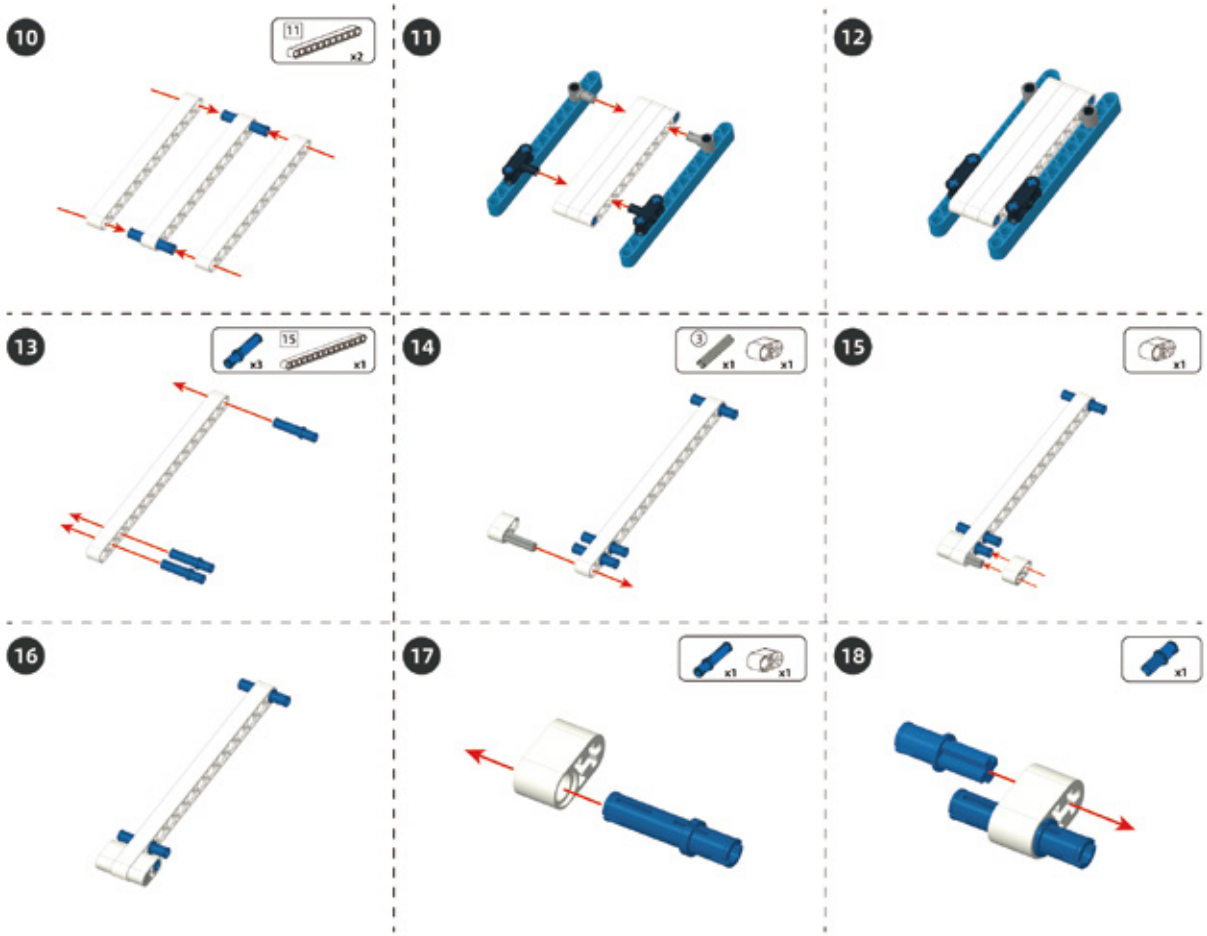
2. Program Driven: The color sensor can read the R, G, B value of the object using the block.

Block	Example
 Explanation: Get the R, G, B (optional) value of the object	 The picture below shows the RGB value of a yellow object 

5. Model Building

- **Structure Building:**


01
x1
x1
02
x2
03
x2
x1
04
x1
x2
05
13
x1
06
07
13
x1
08
09
11
x1
x2


10
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x2
11
12
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15
x3
x1
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x1
x1
15
x1
16
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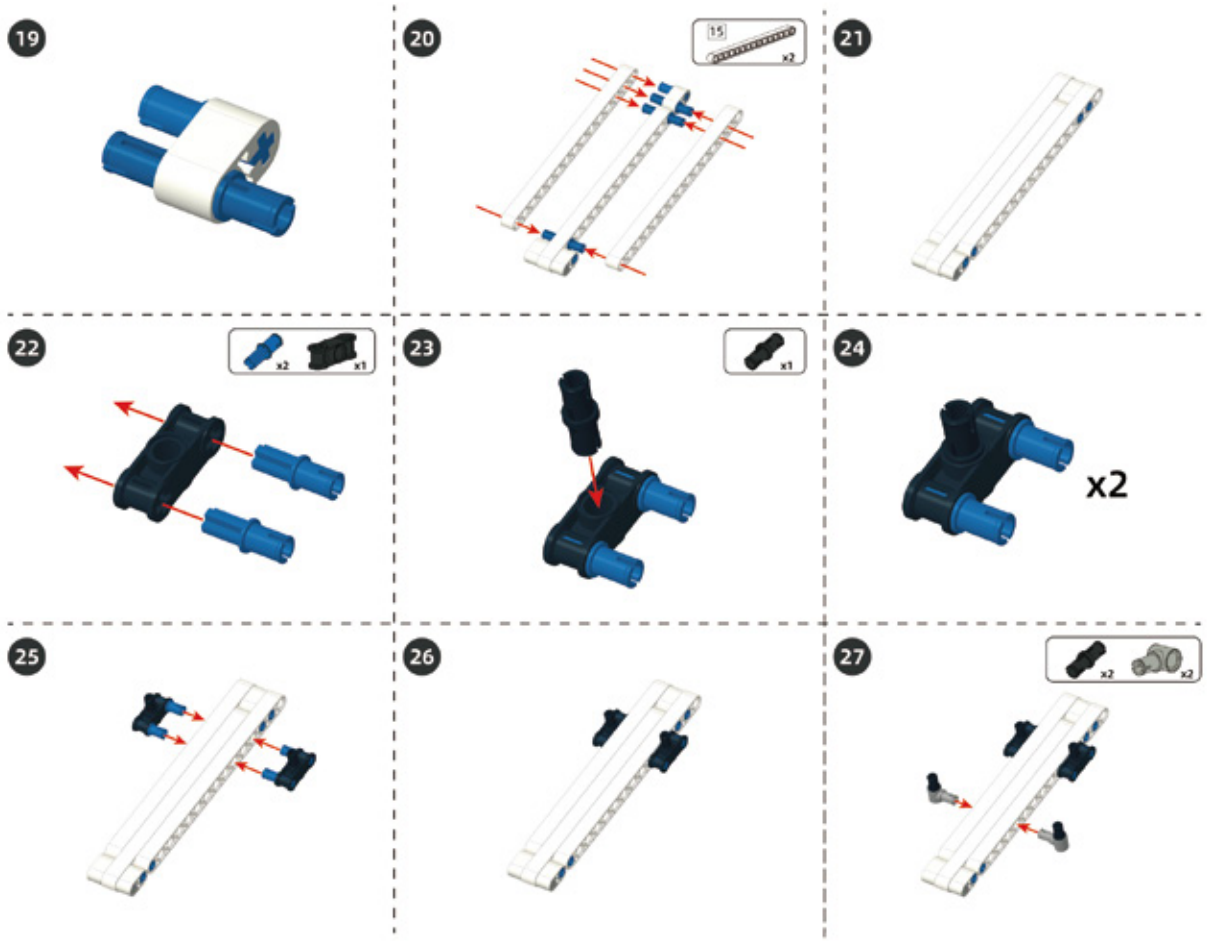
x1
x1
18
x1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x2
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x2
x1
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x1
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x2
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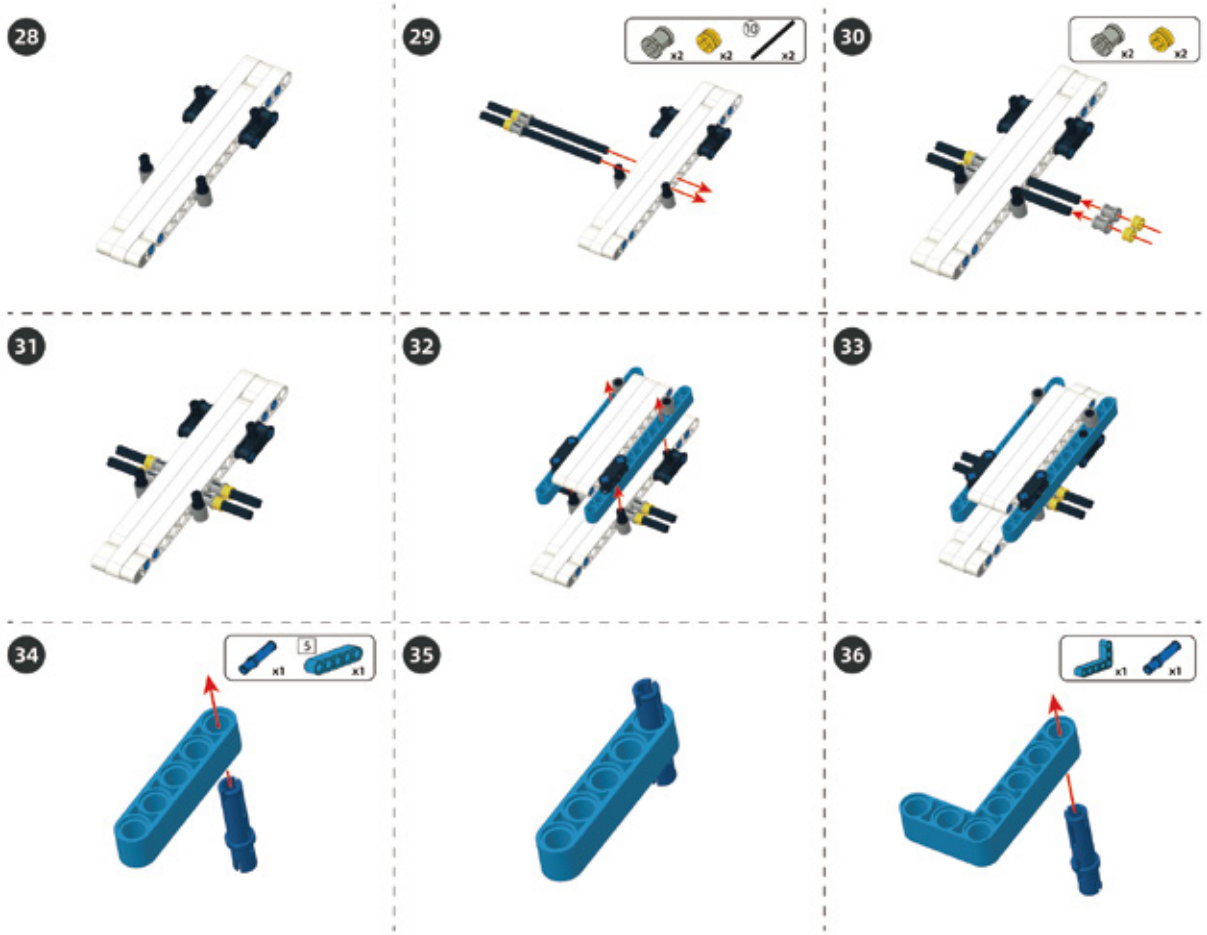
27
x2
x2


28
29
x2
x2
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x2
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x2
x2
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x1
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x1
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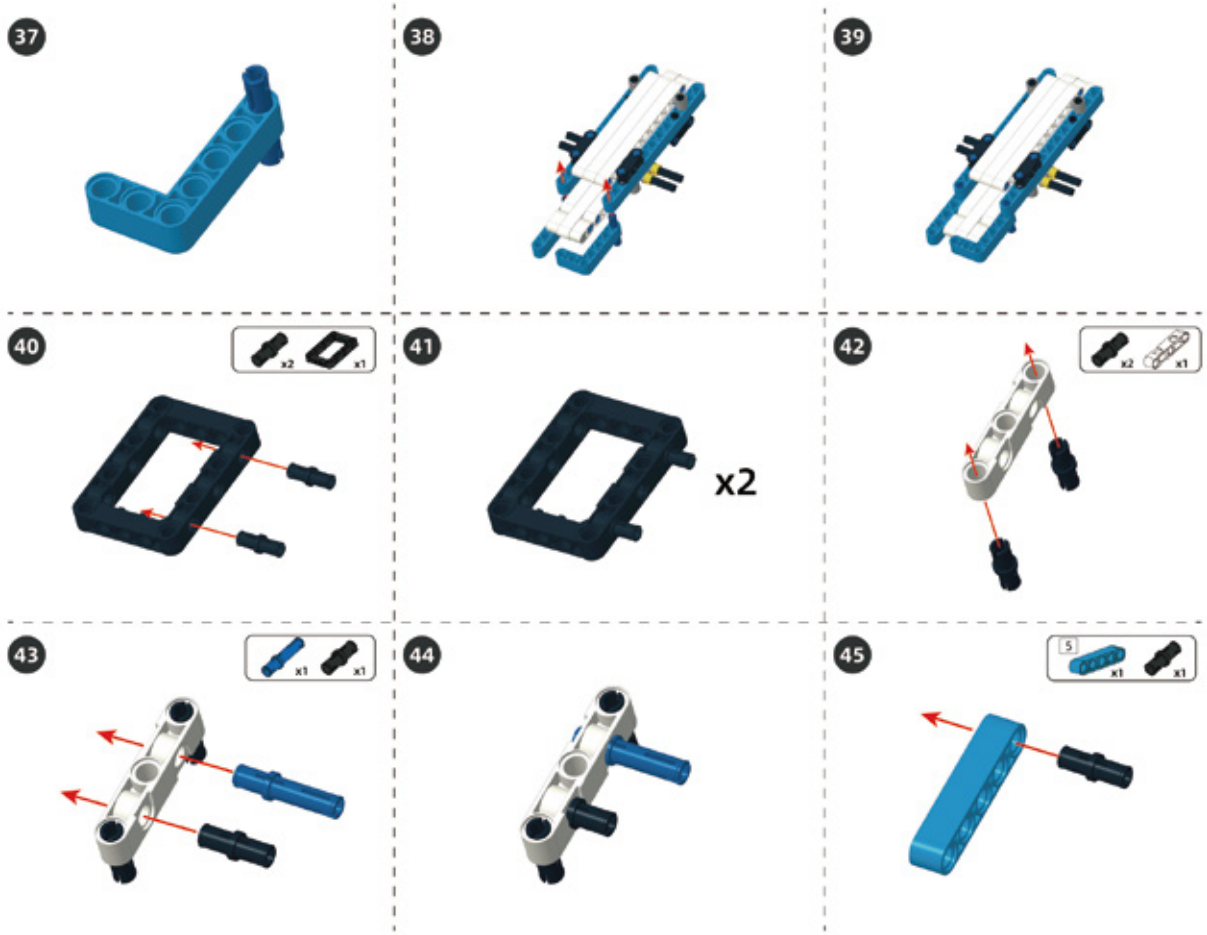
36
x1
x1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x2
x1
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x2
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x2
x1
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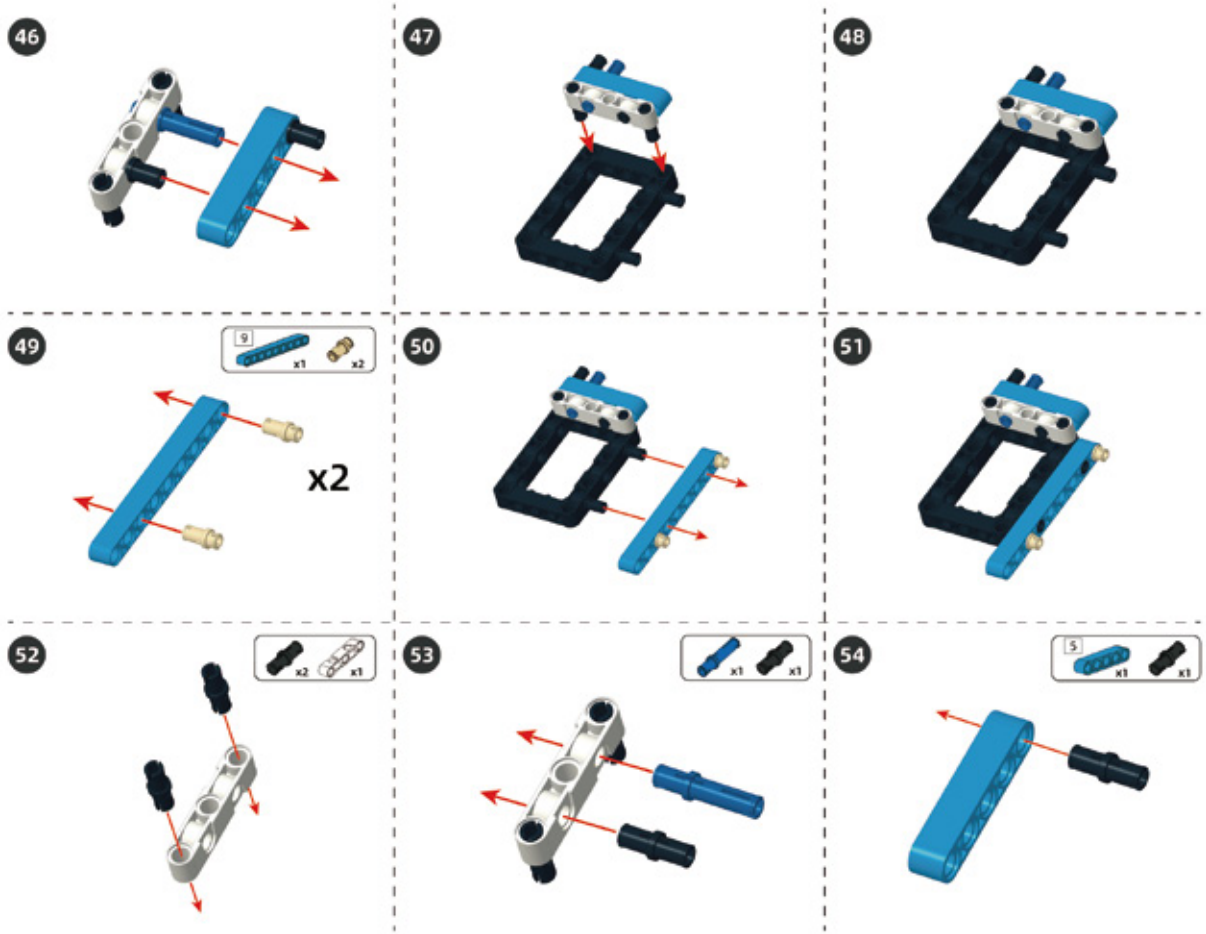
x1
x1
44
45
5
x1
x1


46
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48
49
9
x1
x2
x2
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52
x2
x1
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x1
x1
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x1
x1

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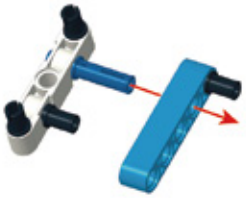

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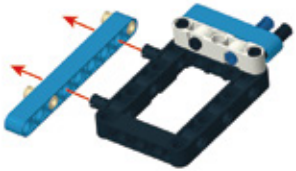

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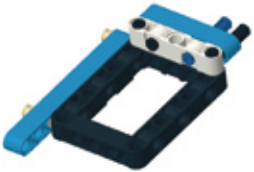

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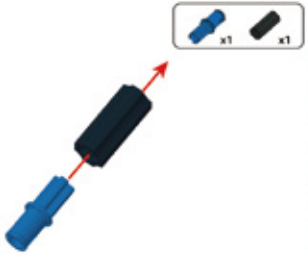

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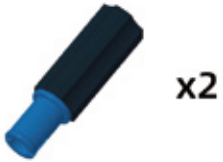

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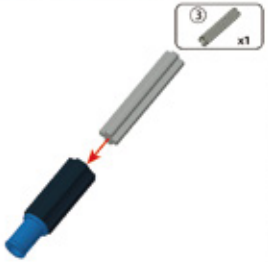

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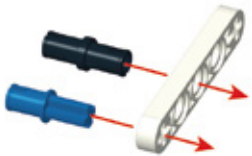

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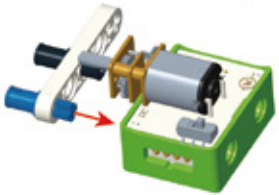

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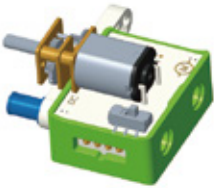

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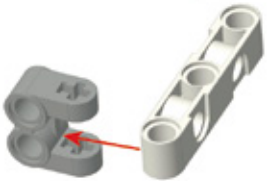

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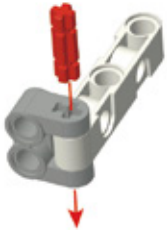

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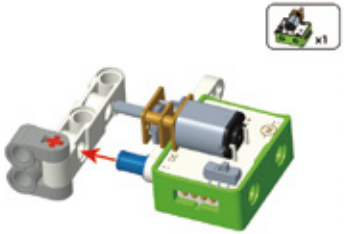

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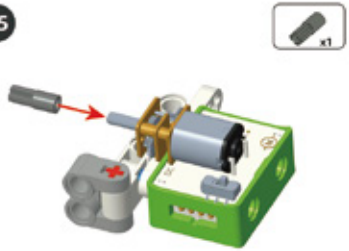

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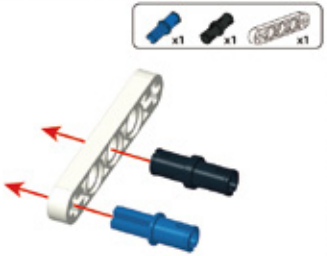

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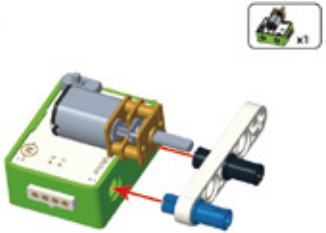

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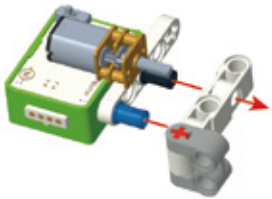

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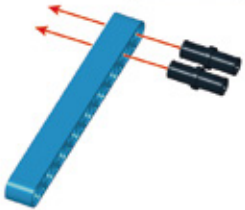

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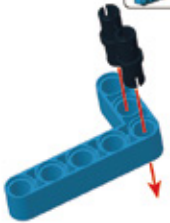

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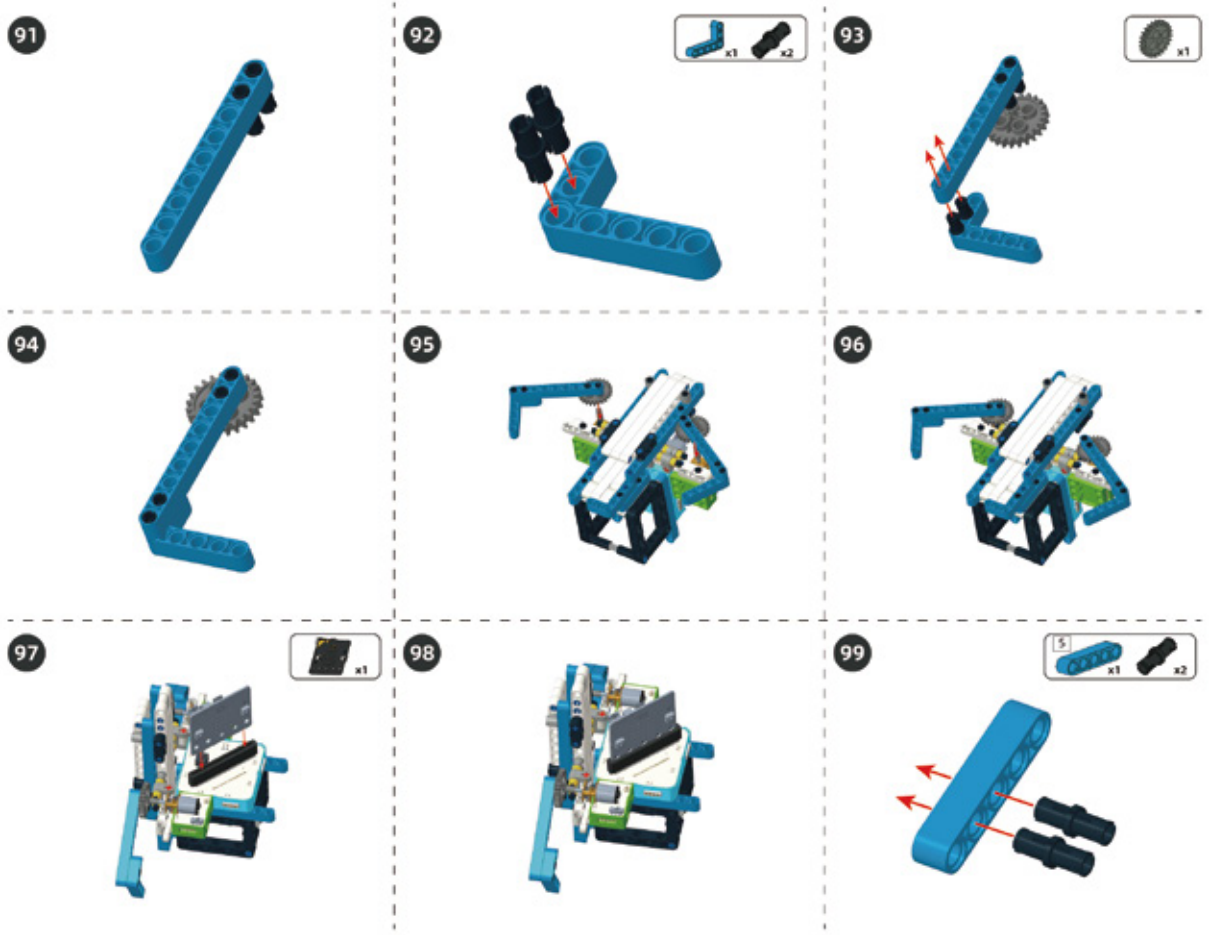
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x1
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x1
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x1
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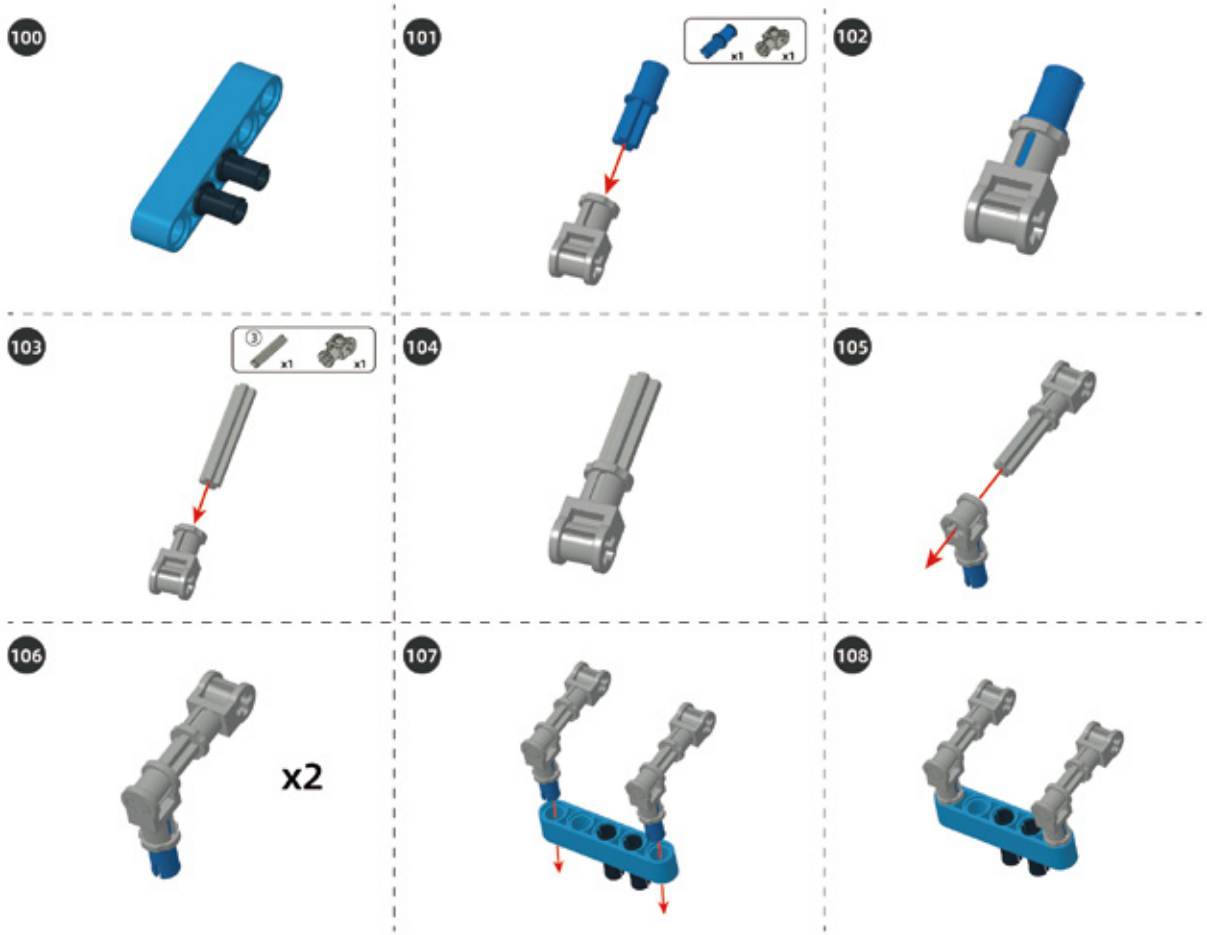
5
x1
x2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x1
x1
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x1
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x2
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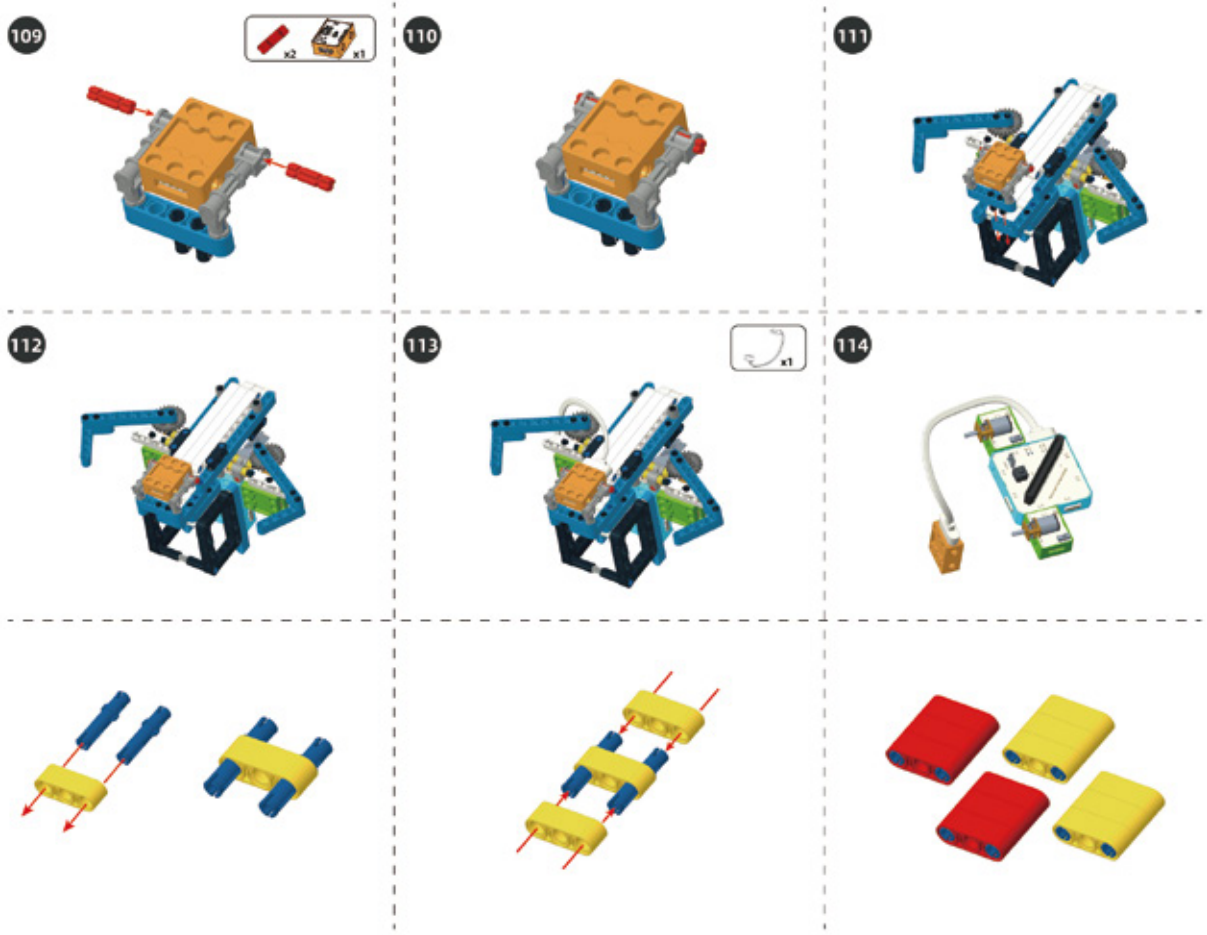
109
x2
x1
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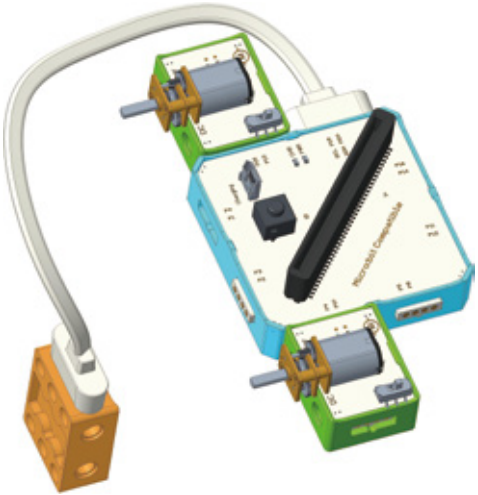
x1
114

• **Circuit Connection**

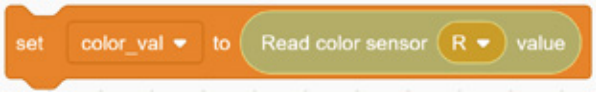
Connect the circuits as shown below:



6. Task to Practice

Task Goal: Sort red color bricks and yellow color bricks. Yellow is collected on the left of the "color sorter" and red is collected on the right.

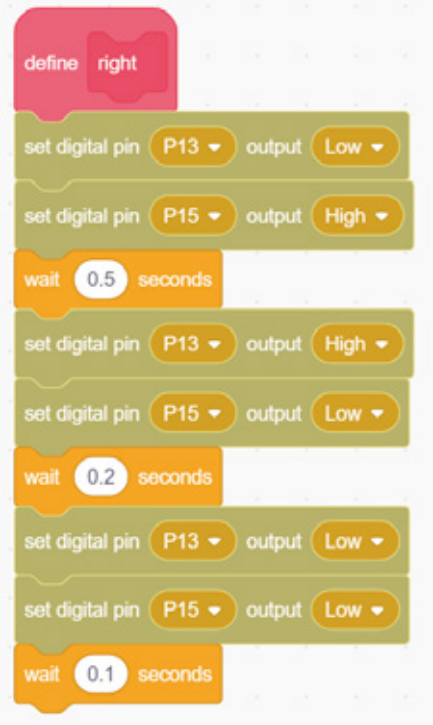
Task Analysis: Firstly, define a variable to store the R value of the measured object.



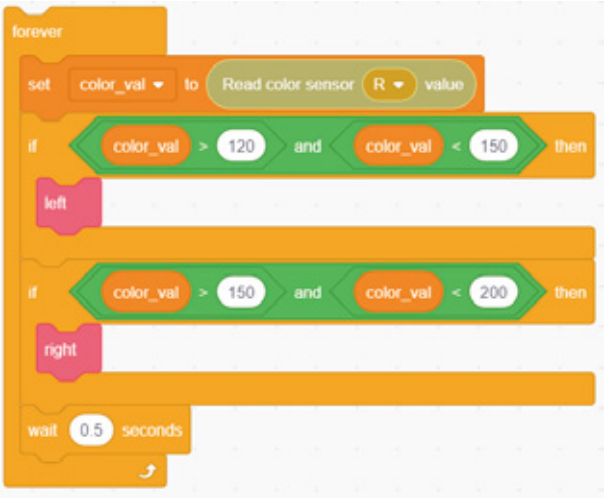
Secondly, define the actions of pushing left and pushing right that controls by two motors, which would be convenient to call after we make the judgment.

1. After the left motor performing the action of pushing right, it turns back to the left and keeps stopping.

2. After the right motor performing the action of pushing left, it turns back to the right and keeps stopping.

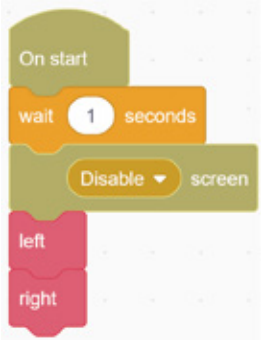


3. Write a program according to the actual measured color value range. The program for reading the color value and the program for judging the value need to be placed in the main loop. Because the R value of yellow and red are completely different, here we only need to detect the R value of the color to judge the bricks' color. If there are more colors or similar colors, you need to detect the values of the other two colors to distinguish different colors of objects.



The R value of yellow color brick ranges from 120 to 150, and the R value of red color brick ranges from 150 to 200. The program determines the pushing direction according to the different R values returned by the sensor, and separates the bricks. This value may be different in different environments, so you need to test it first to determine the range of the value before using it.

4. Finally, the program needs to be initialized. Wait for 1 second at first, so that you can move both hands away from the color sorter. And then disable dot matrix screen to release the port occupied by the dot matrix screen by default. Next, call the motor program once to make the motor rotate to the initial position.



For the complete program, please visit the official website to download: forum.elecrow.com.

7. Game Interactions

Let's invite your good friends to play the color sorter!

Two players work together, one is responsible for placing the color bricks, and the other is responsible for collecting the sorted color blocks. Let your color sorter keep working.

8. Brainstorming

We have learned how to use a color sensor and 2 DC motors to make a color sorter. Think about what other fun projects we can achieve with the sensors we learned. For example, attach a color sensor to a car. When it detects red, the car stops; when it detects green, it moves forward quickly; and when it detects yellow, it moves forward while honking.

Project 9 Bluetooth Car

1. Learning Goals

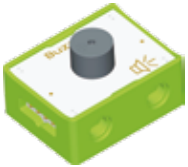
1. Learning practical application of Bluetooth.
2. Learning working principle of Bluetooth control.
3. Mastering the building and programming of Bluetooth car.

2. Application

Bluetooth is a wireless technology standard used for exchanging data between fixed devices, mobile devices and building personal area networks over short distances. Normally we used it in mobiles, computers, toys, wearable devices and other electronic products. Most toy cars controlled by mobile phones are connected via Bluetooth. Now let's make our Bluetooth car.

3. Supplies List

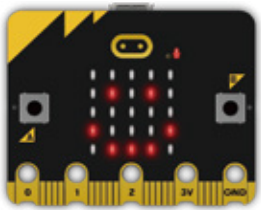
• **Electronic Supplies:**



Buzzer x1

LED x1

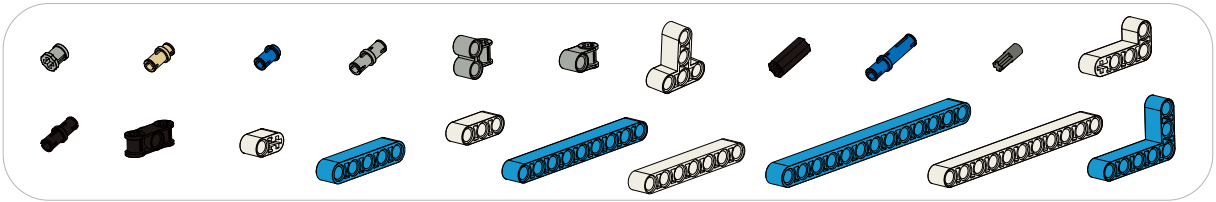
DC Motor x2



Micro:bit x1

Micro:bit Compatible x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**

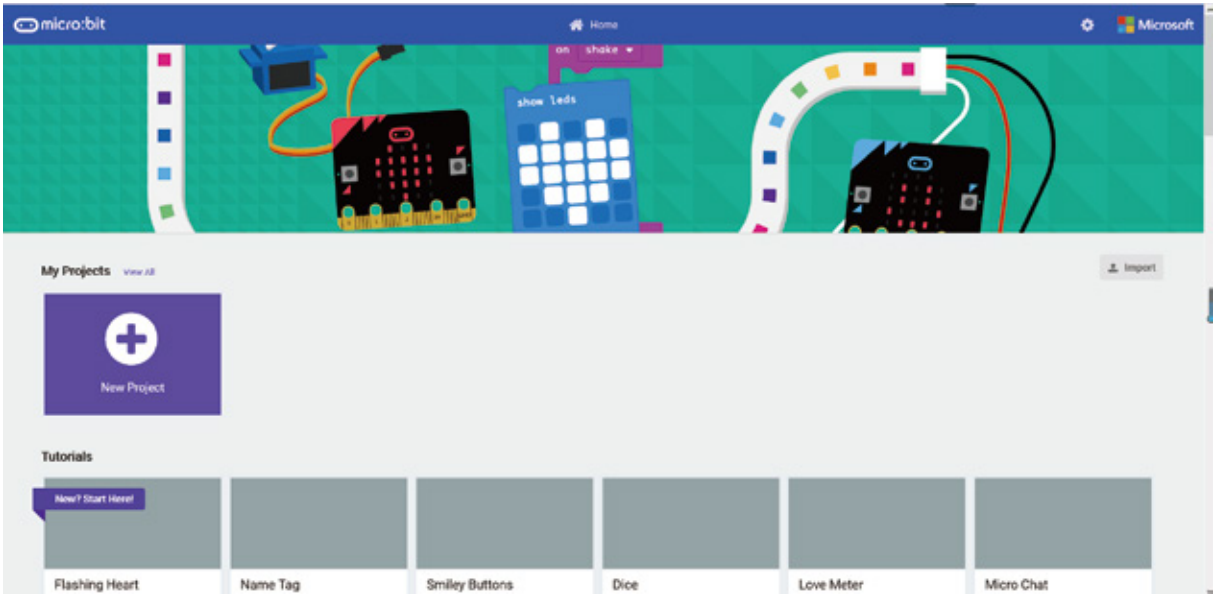


4. Knowledge Analysis

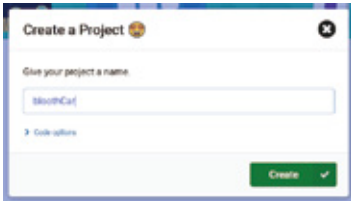
Due to the Makecode doesn't open bluetooth function, so we can't use Letscode sofware this project, we will use makecode online software for programming.

Here is the website of Makecode: https://makecode.microbit.org/

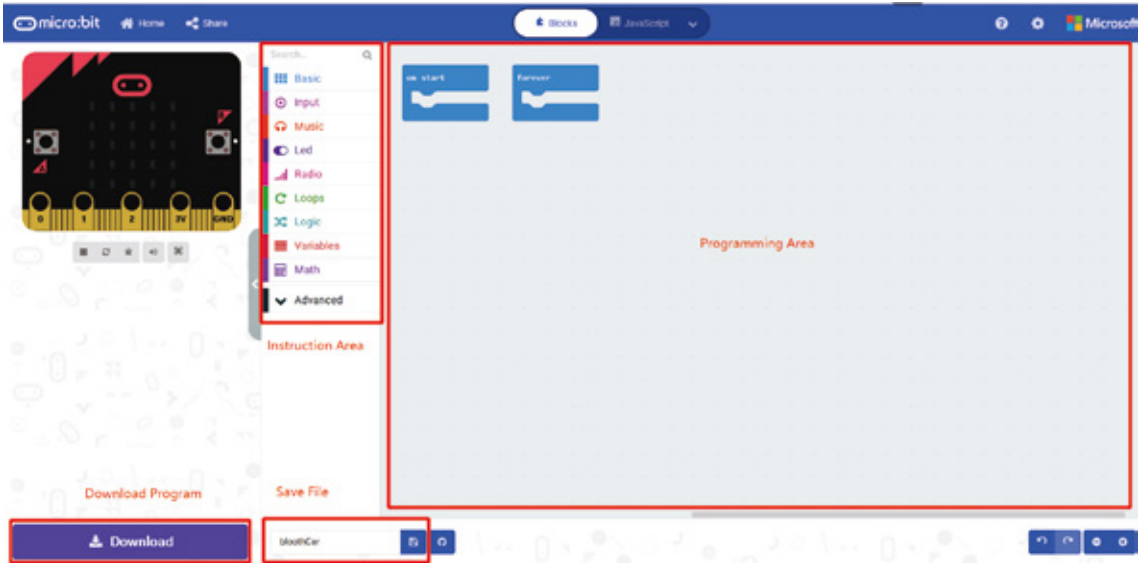
After you log in the website, you will see the following interface:



Then click the button of “New Project” and giving a name for your project like “Bluetooth car”.

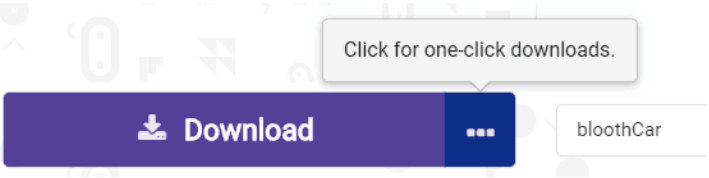


After creating a new project, you will see several areas like the instruction area, programming area, save files area which is the same as with Letscode. Any doubt to use them you can review the Letscode software introduction again.

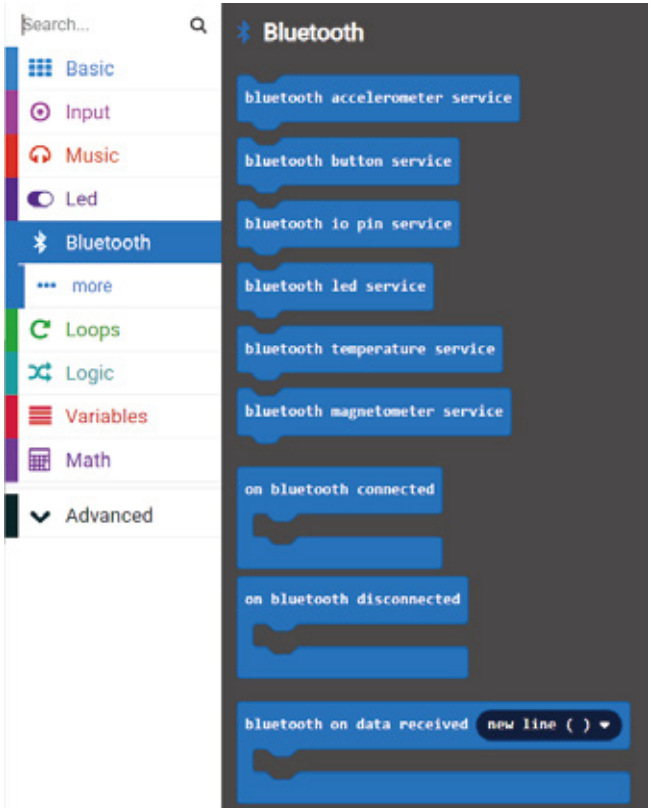


Then connect the micro:bit to your computer with a USB cable and move your mouse to the blue area next to the Download Area and you will see “Pair device” and “Download to micro:bit” options. Clicking to “Pair device” to pair the micro:bit.

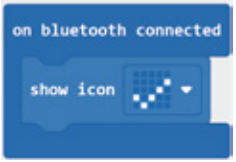
Once “Connected to micro:bit” shown, it means pair successful, and then click the “Download” button to download the software.



Then clicking the “Bluetooth” and “more” buttons in instruction area.



All Bluetooth code blocks will be shown on the right side. In this project, we will only introduce the Bluetooth code blocks that we need to use.

Block	Example
 Explanation: The programs need to be executed when the Bluetooth is connected.	 Showing icon "√", when Bluetooth connected.
 Explanation: The content need to be executed, once Bluetooth disconnected.	 Showing icon "×", when Bluetooth disconnected.
 Explanation: Stating the Bluetooth uart service.	 Initializing Bluetooth uart serice.
 Explanation: Reading Bluetooth uart data.	 If data "1" is reads from Bluetooth uart, then the LED matrix shows the string "Hello!"

Continued

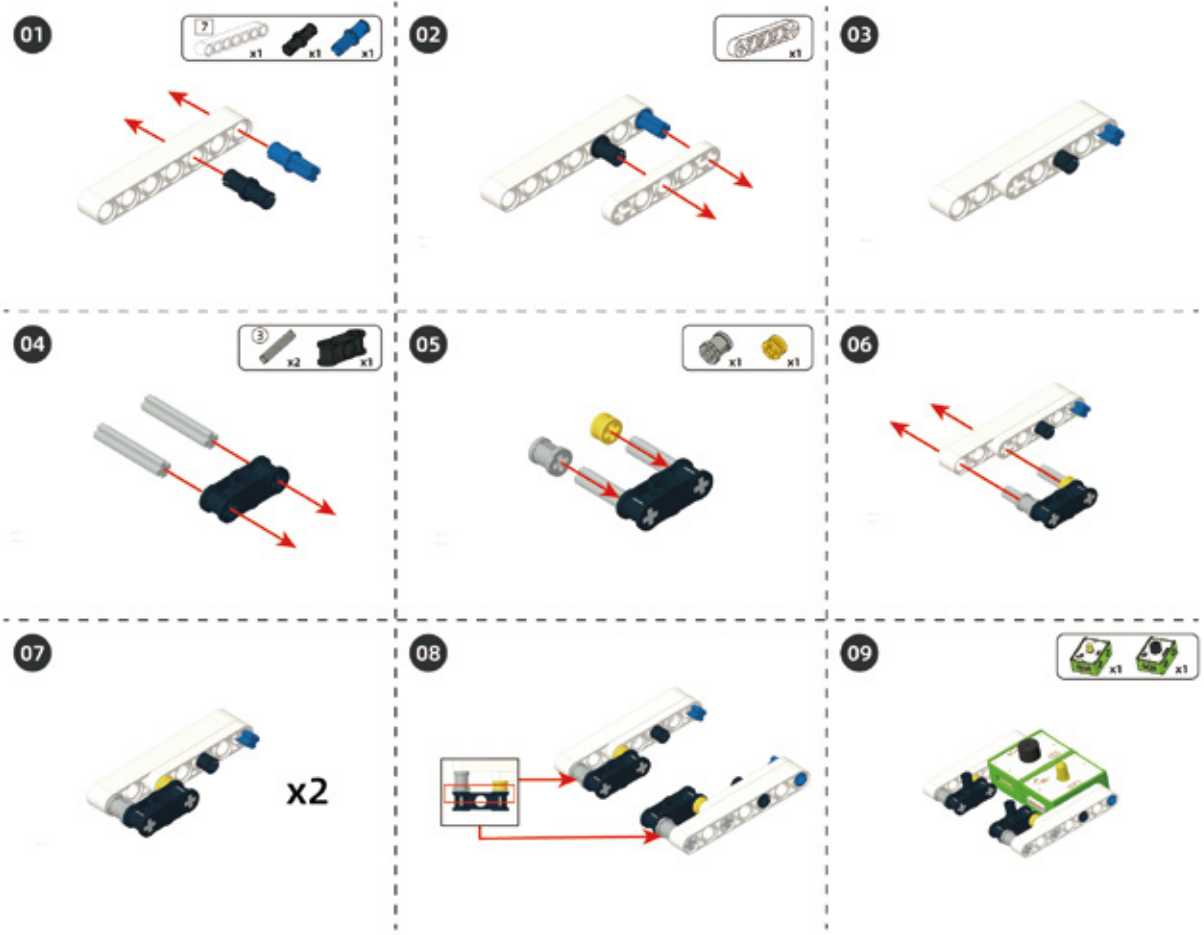
 Explanation: Starting the initialization. Initializing the program that needed.	 Initializing Bluetooth uart service.
	Looping the program.

For information on how the Bluetooth App connects to the Micro: Bit motherboard, please read the instructions for the Bluetooth App.

See the App help for more details.

5. Model Building

- **Structure Building:**


01
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x1
x1
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x1
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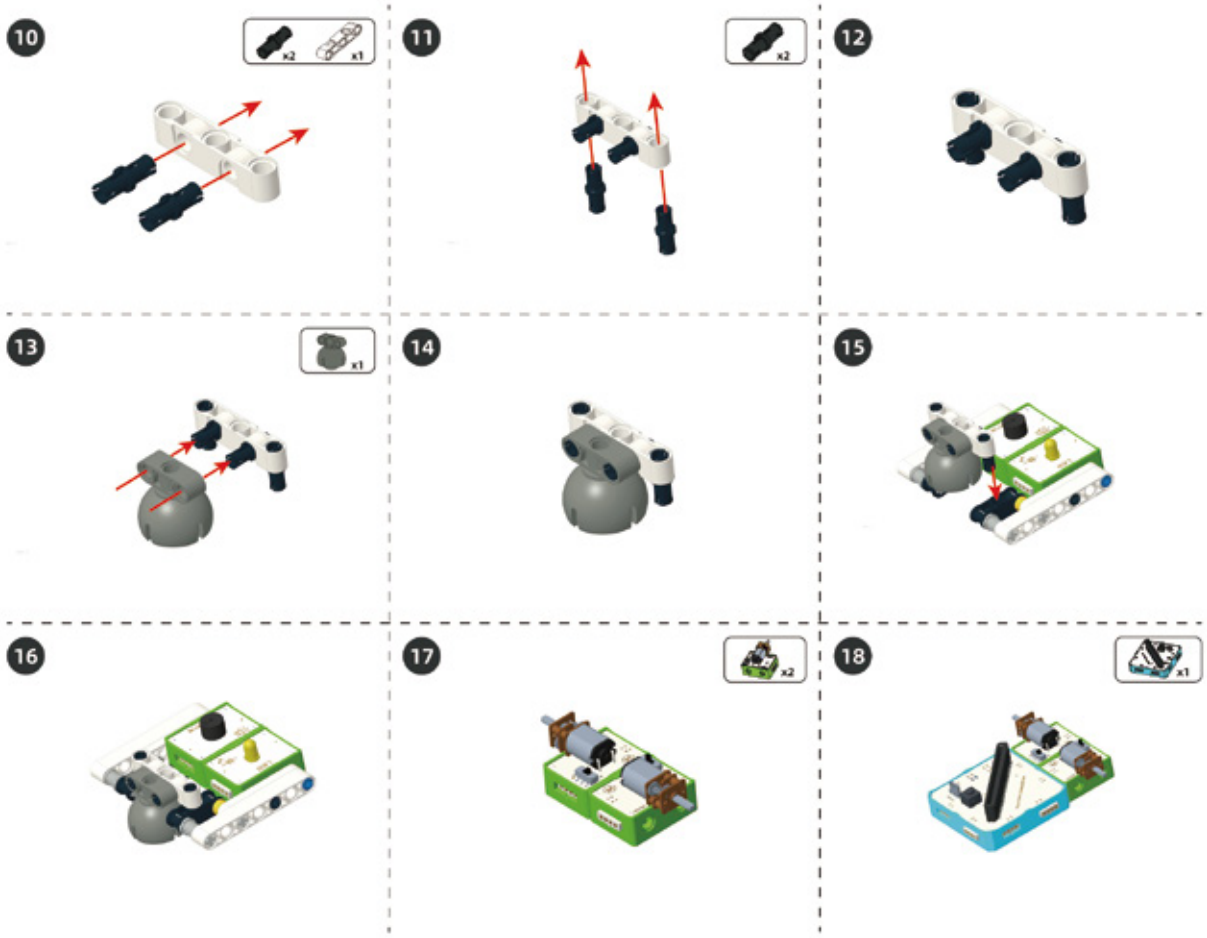
09
x1
x1


10
x2
x1
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x2
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13
x1
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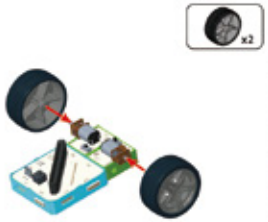
16
17
x2
18
x1

19



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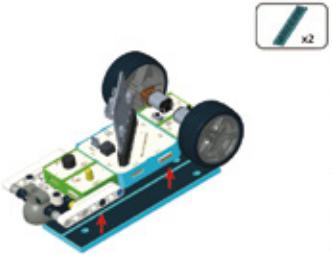

24

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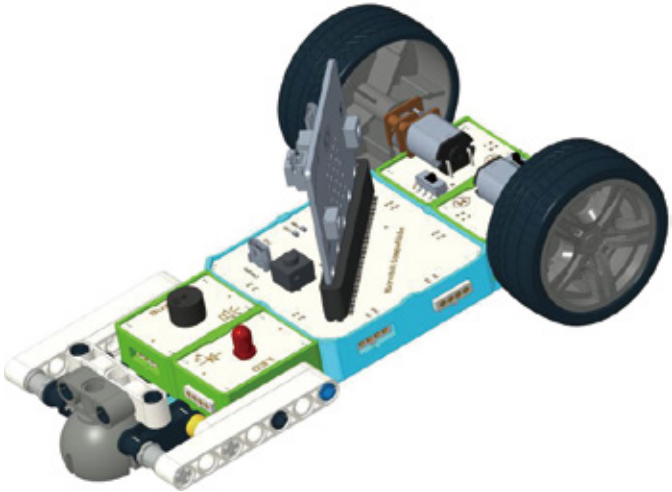
• Circuit Connection

Connect the circuit according to the diagram below.



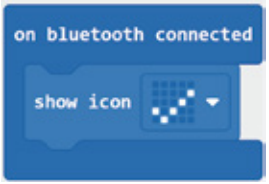
6. Task to Practice

Task Goal: Use buttons “Up”, “Down”, “Left”, “Right” of the app to control the car to go forward, backward, left and right.

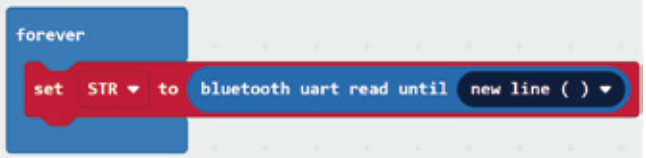
Task Analysis:

Step 1: Start Bluetooth uart service;

Step 2: We can use the following blocks to respectively represent the two status of Bluetooth connected and disconnected;



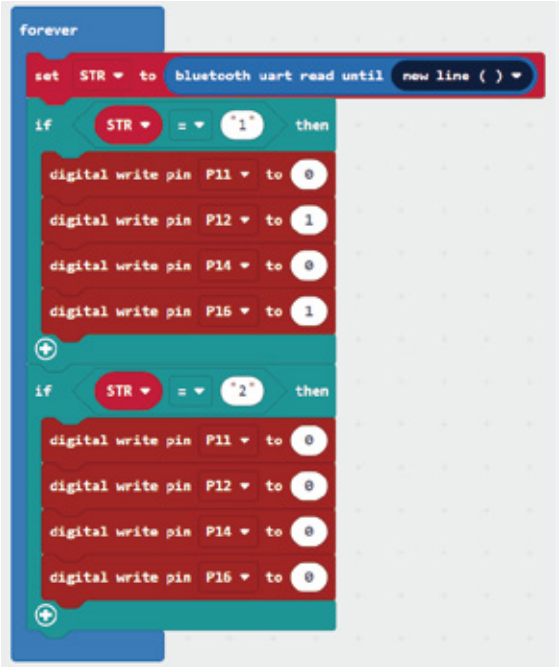
Step 3: we can set a variable to store the data reads from the uart;



Step 4: The data we get from uart is a string type so we need to use comparison blocks to judge the data we get;

Block	 Explanation: Numbers comparison
	 Explanation: Strings comparison
Example	 Judging Numbers
	 Judging Strings

For example, if we want to make the car go forward when pressing the button "Up", and make the car stop when releasing it. We can program as follows:



The data we get from the uart is the string type, which means we need to judge them using string comparison block. Return “1” when the button “Up” is pressed, and return “2” when it is released. Therefore, we can program like this.

Now we can download the program to micro: bit board and use the four direction buttons to control the car. Let’s have a try.

For the complete program, please visit the official website to download: forum.elecrow.com.

6. Game Interactions

Invite your friends to have a remote car race! You can design a racing track with what you have. To increase the difficulty of the game, you also can set some barriers and make the track with width for only one car to pass by. You and your partners can use the app to control the car across the barriers and reach the destination to see who can reach the finishing line without touching any barriers first.

7. Brainstorming

We have used Bluetooth modules in this lesson to control the car by using the buttons of "Up", "Down", "Left", "Right" of the Bluetooth APP. Have you noticed there are some other buttons like "A" to "F" which you can use to add some new and special functions for your car? Like pressing button "A", the LED will light in the frequency of 3 times per second. Or when you press button "B", the buzzer will start to ring, and after you release the button, the ring will stop. There are so many other functions for you to explore. Just use your imagination to create some other special features for your car.

Project 10 Lawn Mower

1. Learning Goals

1. Know the structure and operating principle of lawn mower.
2. Learn the conversion of strings and numbers.
3. Complete the building and programming of lawn mower.

2. Application

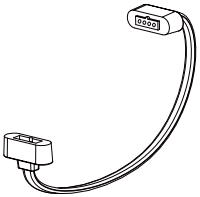
Taking care of a lawn is a very labor-intensive task. For instance, if 200 workers are hired in the estate of Blenheim, then 50 of them would be asked to take care of lawns. In the wild season, the grass needs to be mowed about every ten days, which takes a lot of time and energy. With the rapid rise of the lawn industry, scientists invented the lawn mower.

Next, let's make a lawn mower!

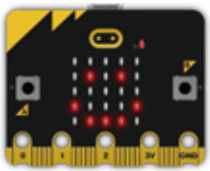
3. Supplies List

- **Electronic Supplies:**

DC Motor x2



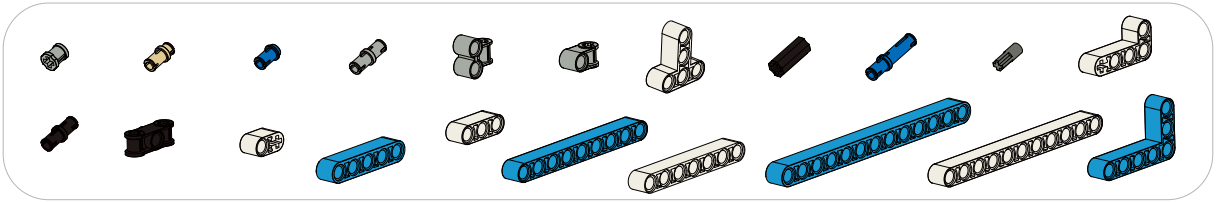
Magnetic Cable x2



Micro:bit x1

Micro:bit Compatible x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



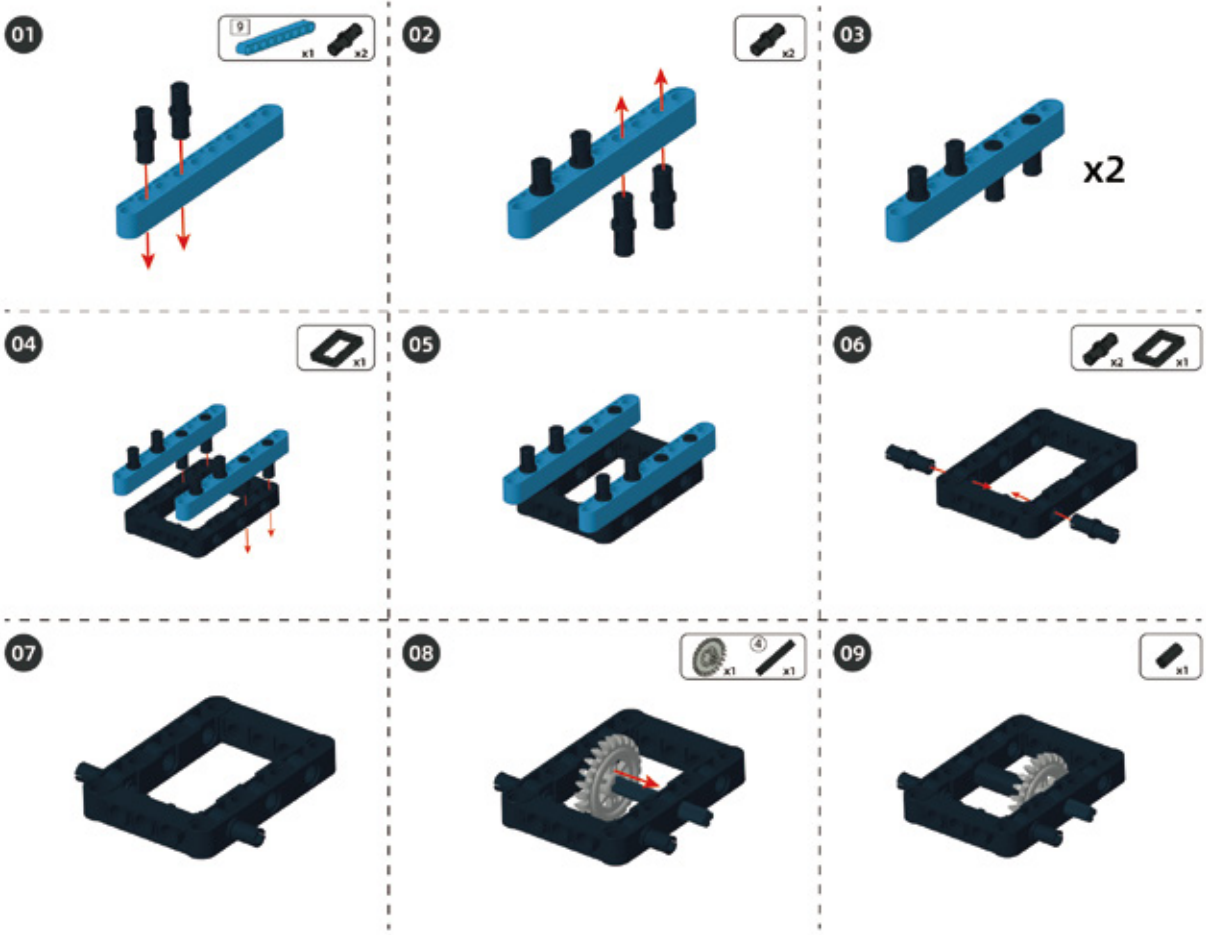
4. Knowledge Analysis

Just the same as the previous lesson, we need to use Bluetooth uart service here. Previously, we use the comparison between strings, but sometimes we need to do numerical operations. So we need to convert the string read from the uart port to a numeric type using the following blocks.

Block	Example
 Explanation: Converts a string to a numeric type	Converts a string read from the Bluetooth uart port to a numeric type

5. Model Building

• **Structure Building**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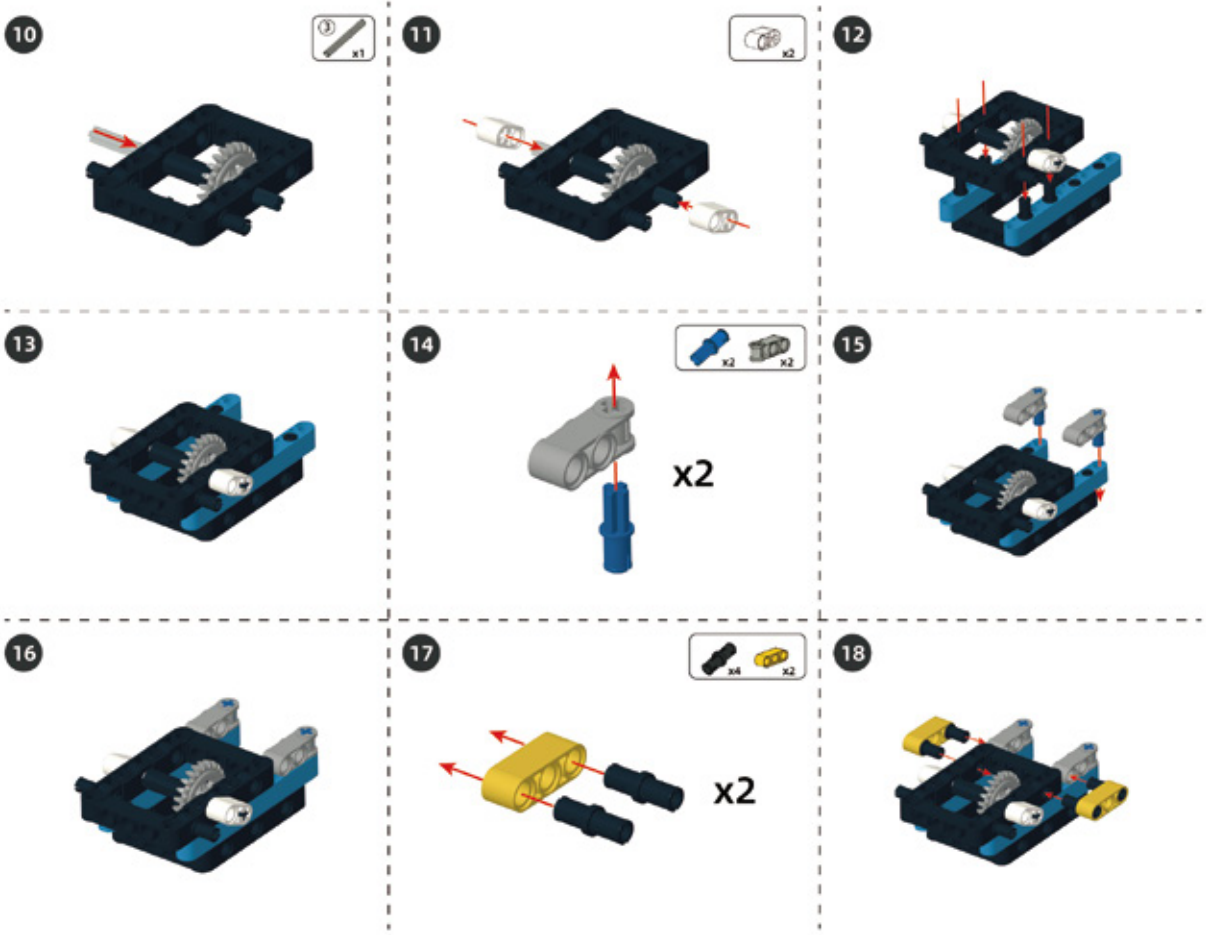
x1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x1
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x2
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x2
x2
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x4
x2
x2
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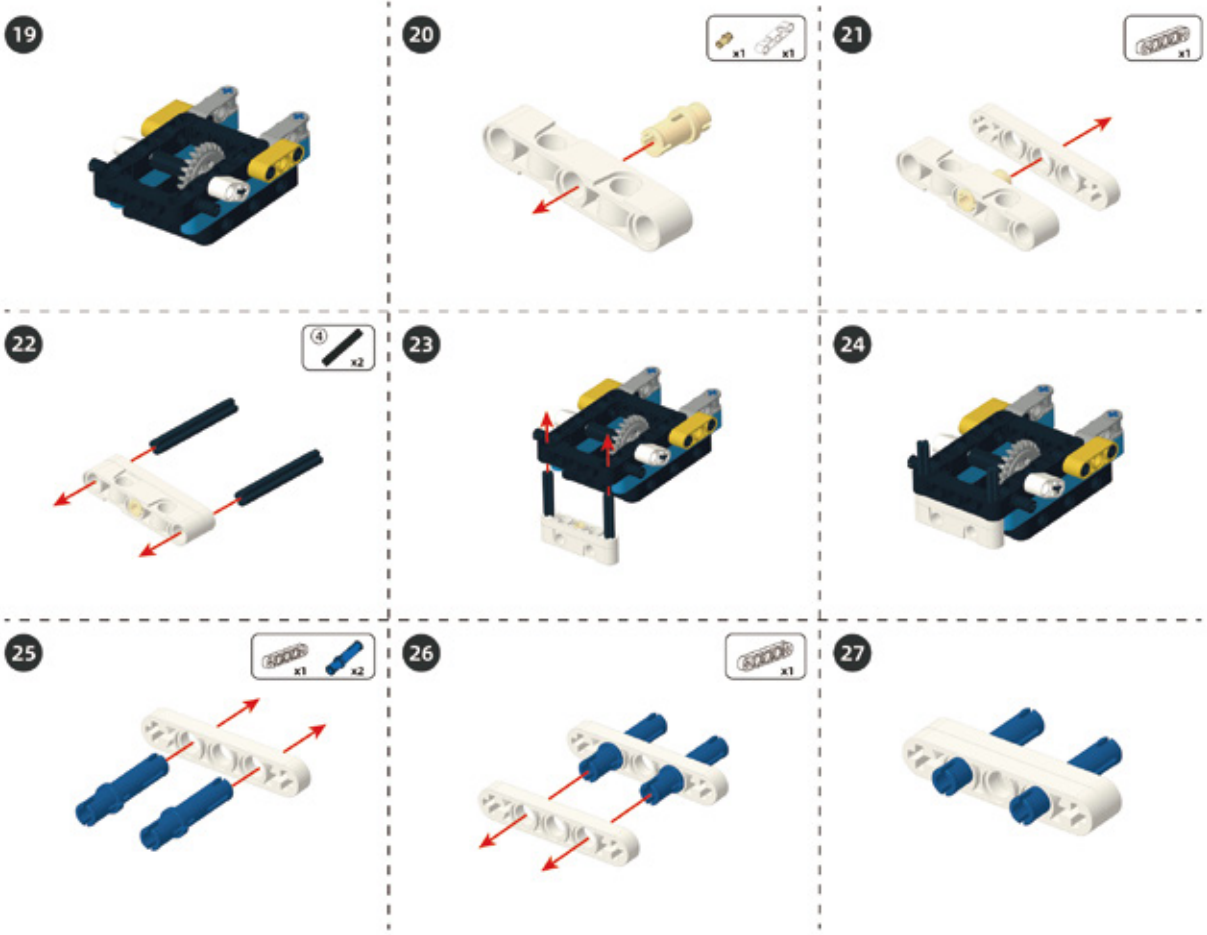
19
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x1
x1
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x1
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x2
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x2
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x1
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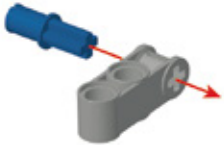

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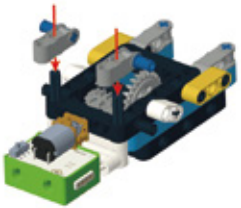

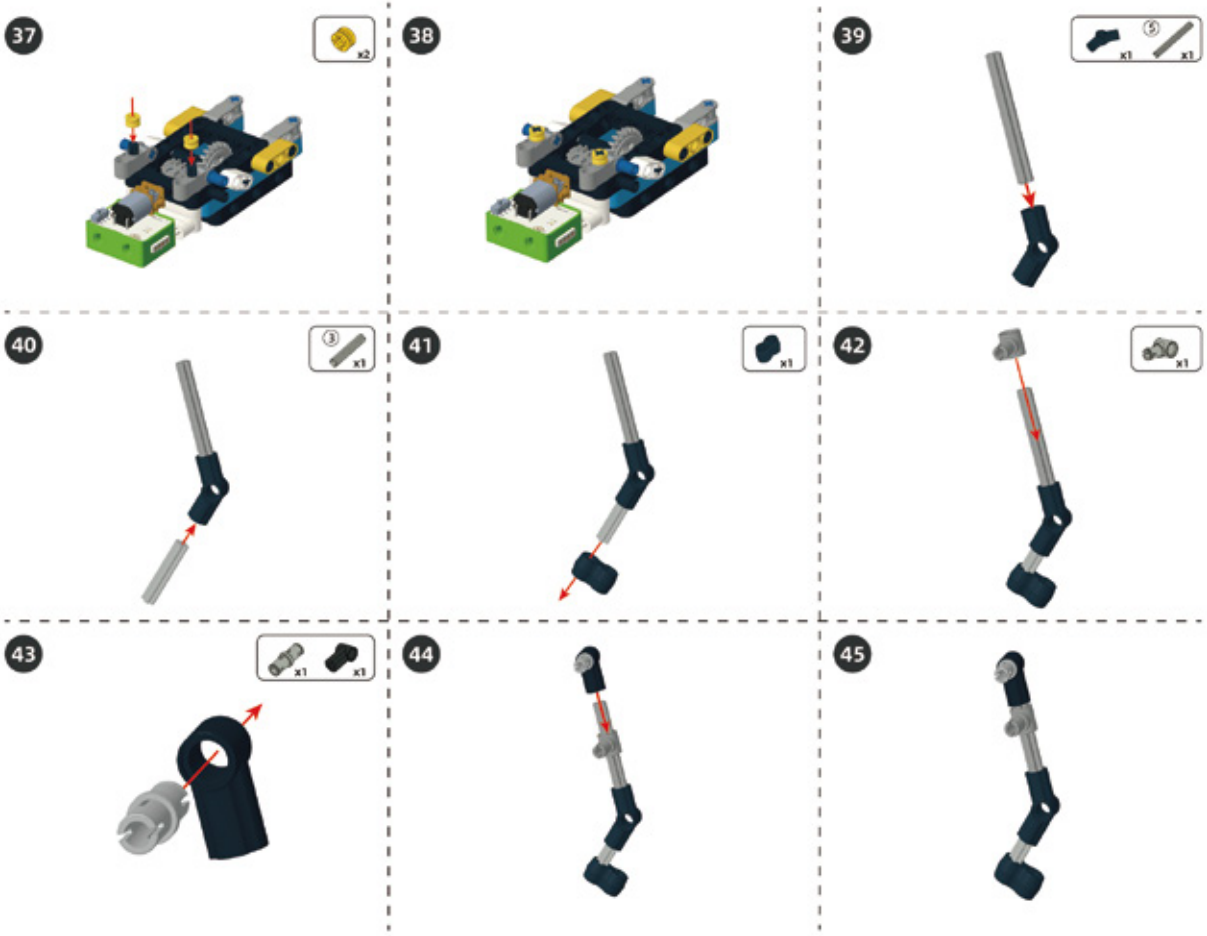
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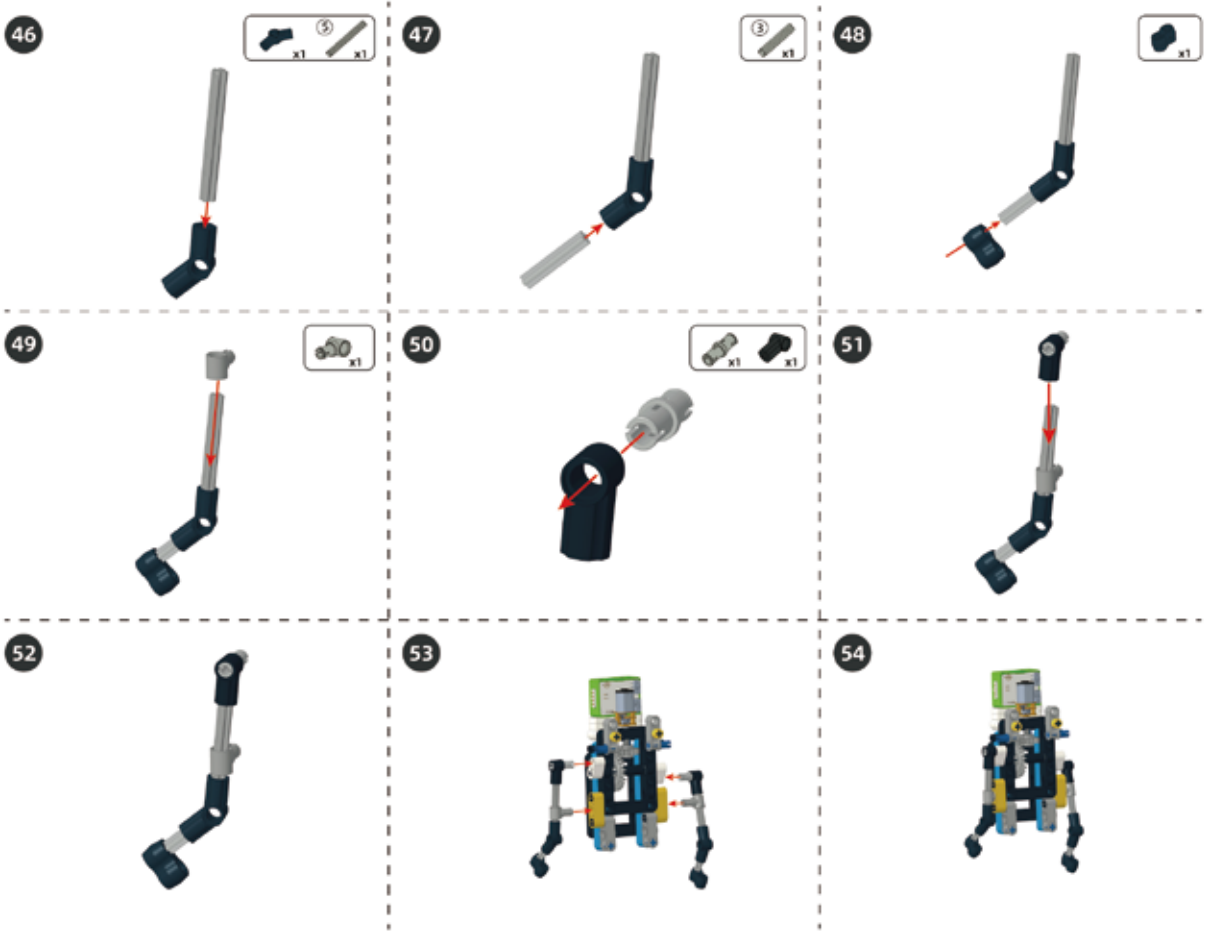
x2
38
39
x1
5
x1
40
3
x1
41
x1
42
x1
43
x1
x1
44
45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x1
x1
47
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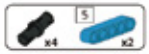

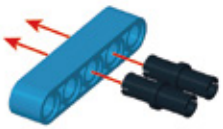

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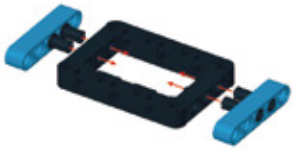

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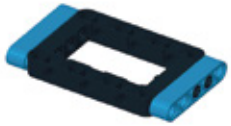

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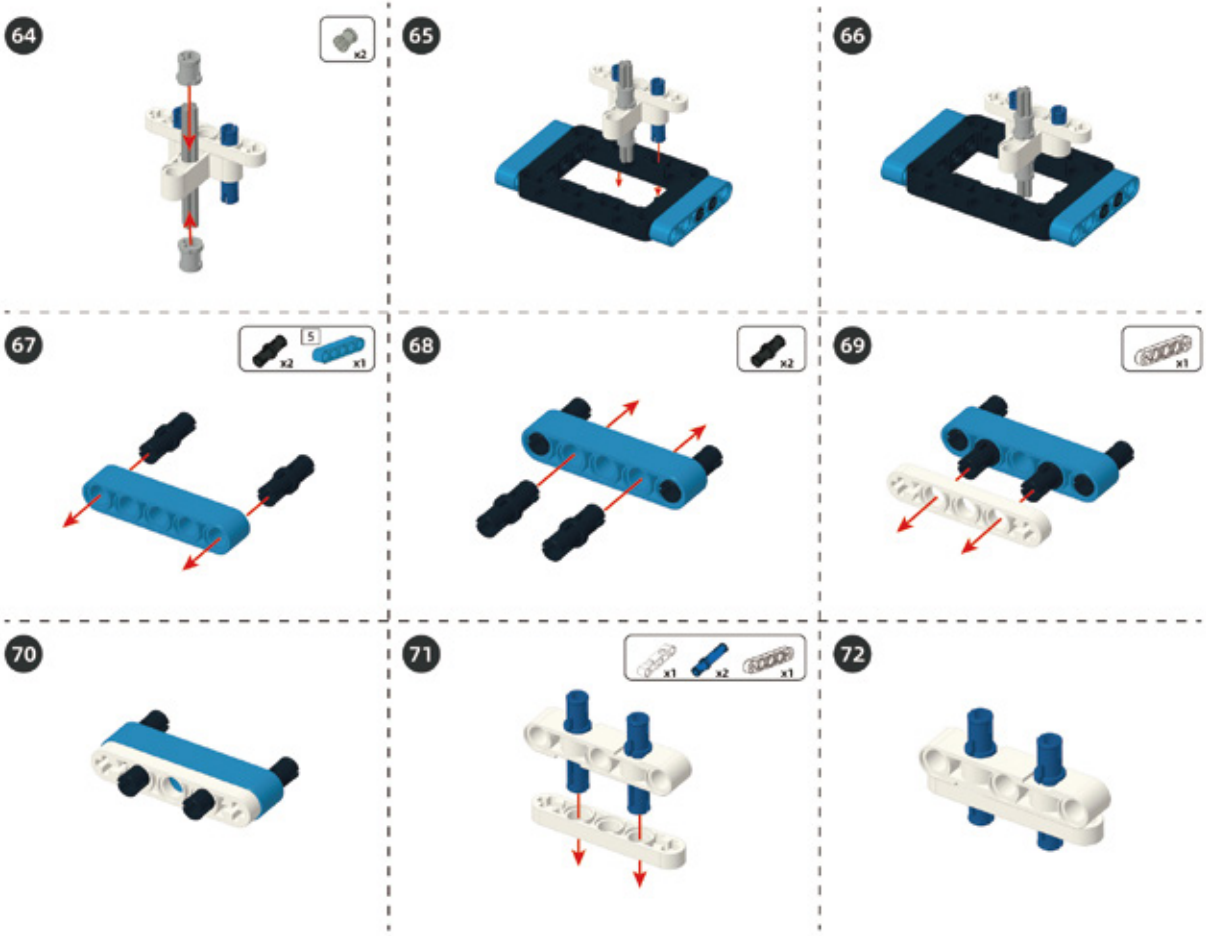
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x2
65
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67
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x2
x1
68
x2
69
x1
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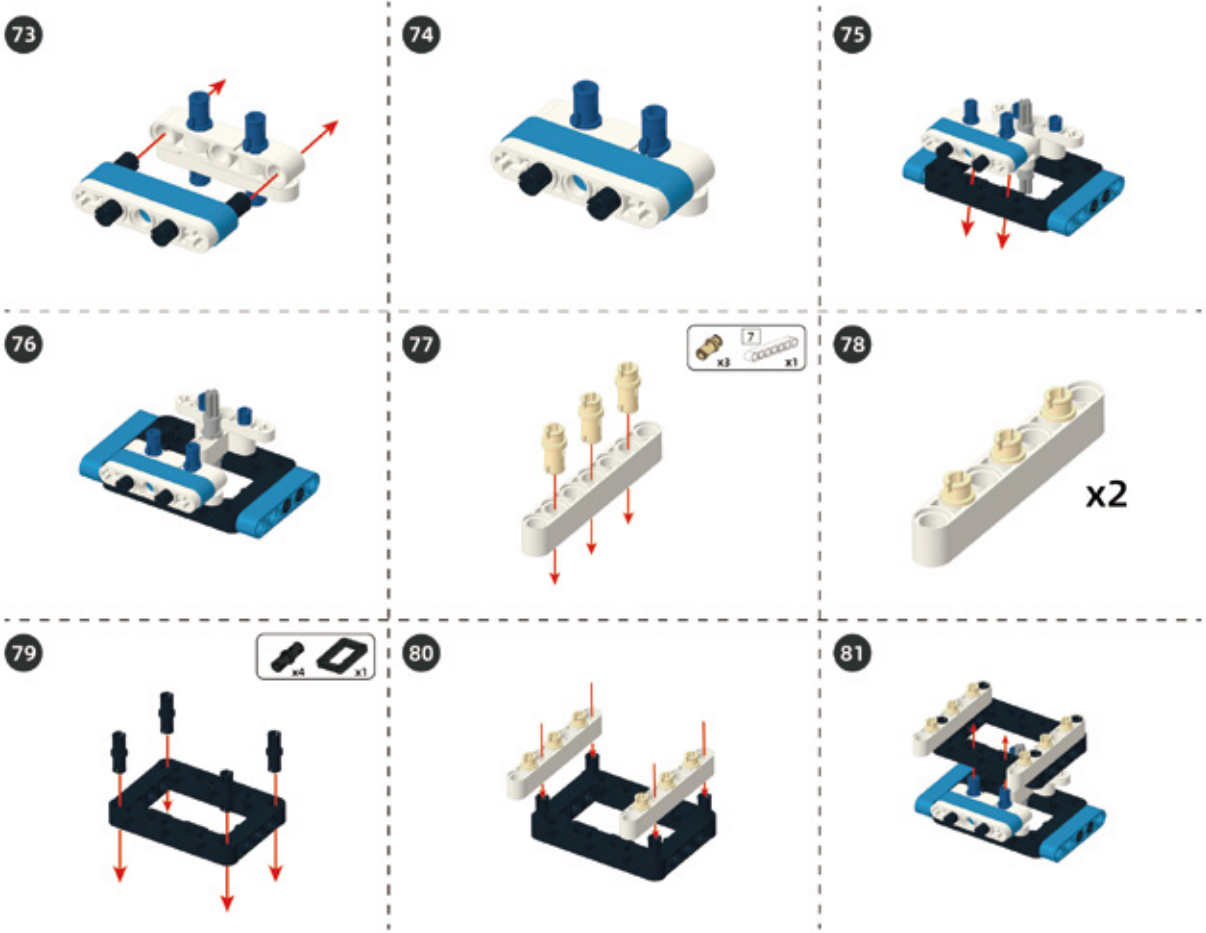
71
x1
x2
x1
72


73
74
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x3
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x2
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x4
x1
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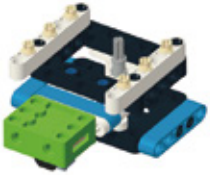

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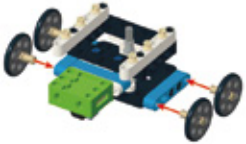

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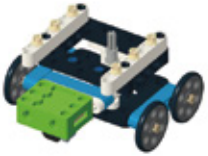
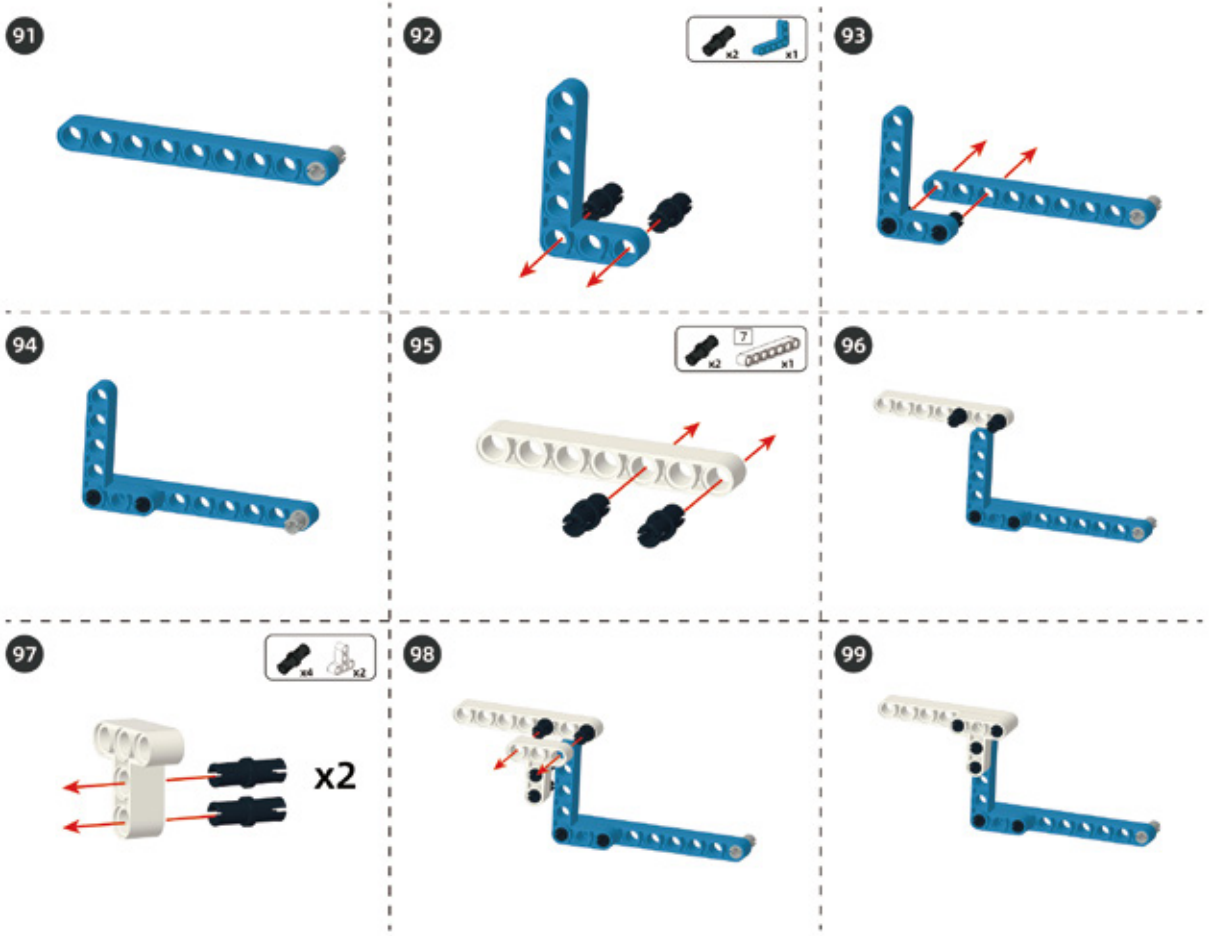


90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92
x2
x1
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x2
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x2
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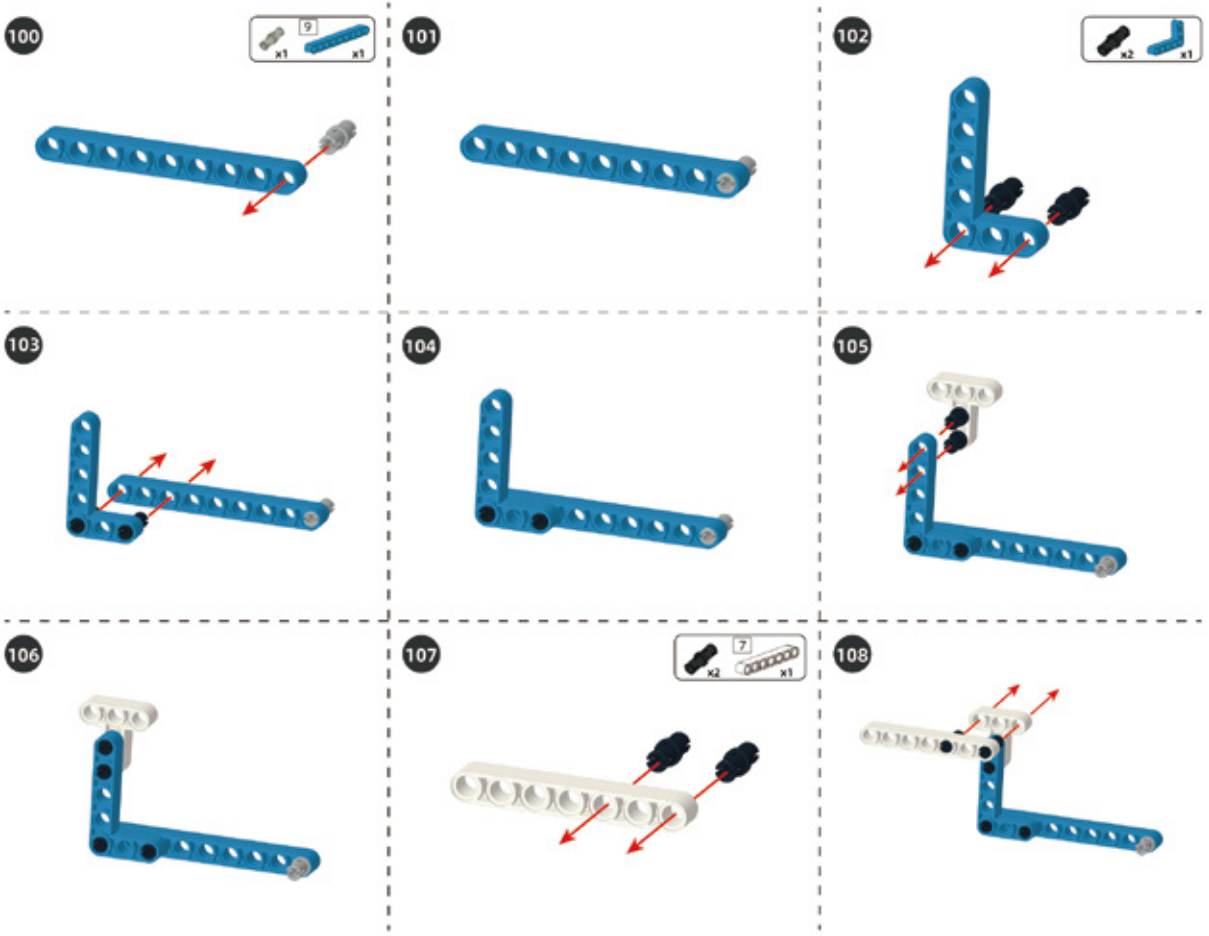
100
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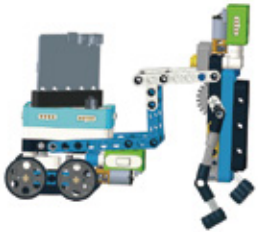

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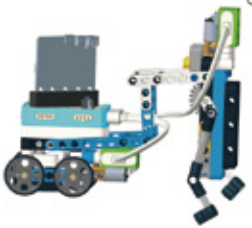

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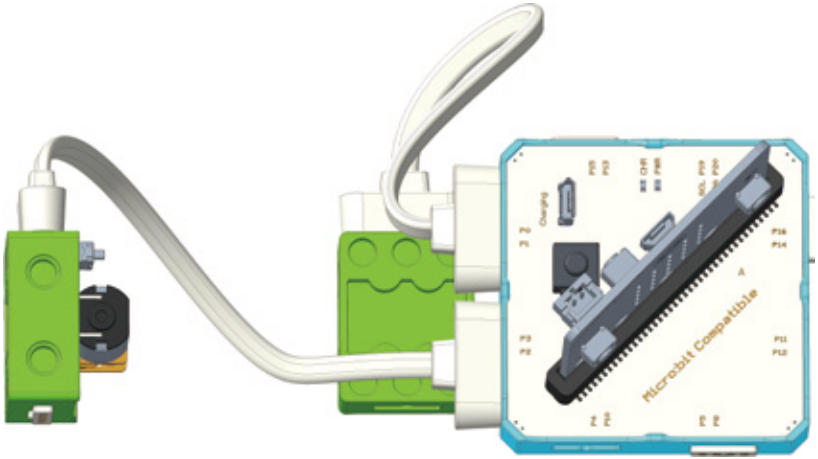
117

• Circuit Connection

Connect them according to following circuit diagram.



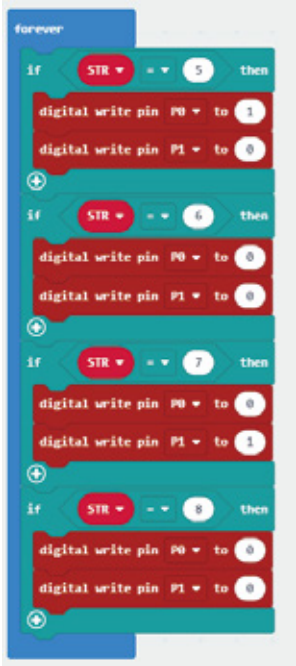
6. Task to Practice

Task Goal: Control lawn mower robot to move forward and backward by using the up and down keys, and rotate forward and backward of motors by left and right key.

Task Analysis: Next we need to judge the data read from Bluetooth Uart. Lawn mower has two motors which we could control separately. One to control the forward and backward movement, the other controls the mowing motion.

1. Control moving forward and backward with up and down keys. Press the up key, the value read from the uart port is 1, lawn mower moves froward; release the up key, the value read from the uart port is 2, lawn mower stops moving. Press the down key, the value read from the uart port is 3, lawn mower moves backward; release the down key, the value read from the uart port is 4, lawn mower stops moving backward.

2. Control mowing motion by left and right key. Press the left key, the value read from the uart port is 5, lawn mower rotates clockwise; release the left key, the value read from the uart port is 6, lawn mower stops rotating. Press the right key, the value read from the uart port is 7, lawn mower rotates counterclockwise, release the right key, the value read from the uart port is 8, lawn mower stops rotating.



Download the program to micro:bit board, and connect it to Bluetooth App of you mobile phone, try to remote control your lawn mower now!

For the complete program, please visit the official website to download: forum.elecrow.com.

7. Game Interactions

Let's mow the lawn together!

First, scatter the waste paper on the ground, which can be thought of as grass. Then use the mowing machine to cut the waste paper, and success if the waste paper turns into messy scraps.

8. Brainstorming

The lawn mower uses two motors and the Bluetooth function. This project's structure is a little difficult, mainly use a gear 90-degree meshing transmission structure. Now observe carefully and think out to make a grinding robot using a similar structure and programming logic.

Project 11 Forklift Truck

1. Learning Goals

1. Know about applications of the forklift.
2. Learning the structure of worms and worm wheels.
3. Mastering the building and programming of the forklift.

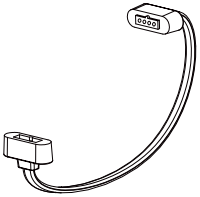
2. Application

As the volume and weight of goods increase, manual handling becomes more and more difficult. To solve this difficulty, the forklift are designed to lift the goods. Do you know the working principle of it? Now, lets make a forklift to figure out how it works.

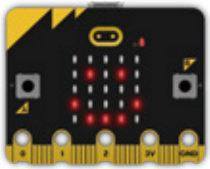
3. Supplies List

• **Electronic Supplies:**

DC Motor x2



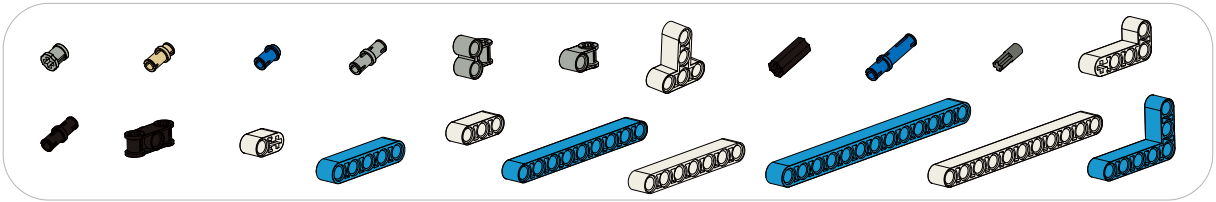
Magnetic Cable x2



Micro:bit x1

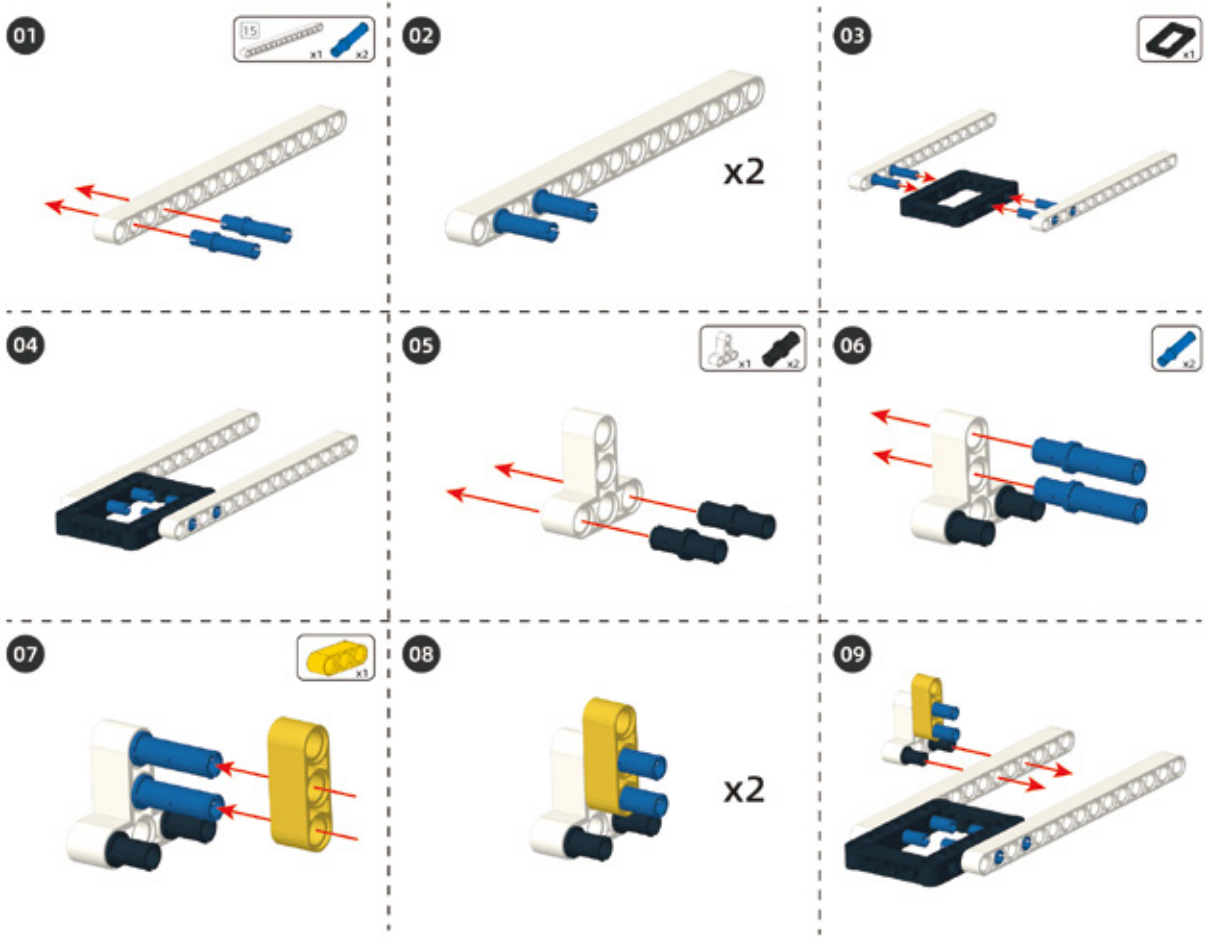
Micro:bit Compatible x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



4. Model Building

• **Structure Building**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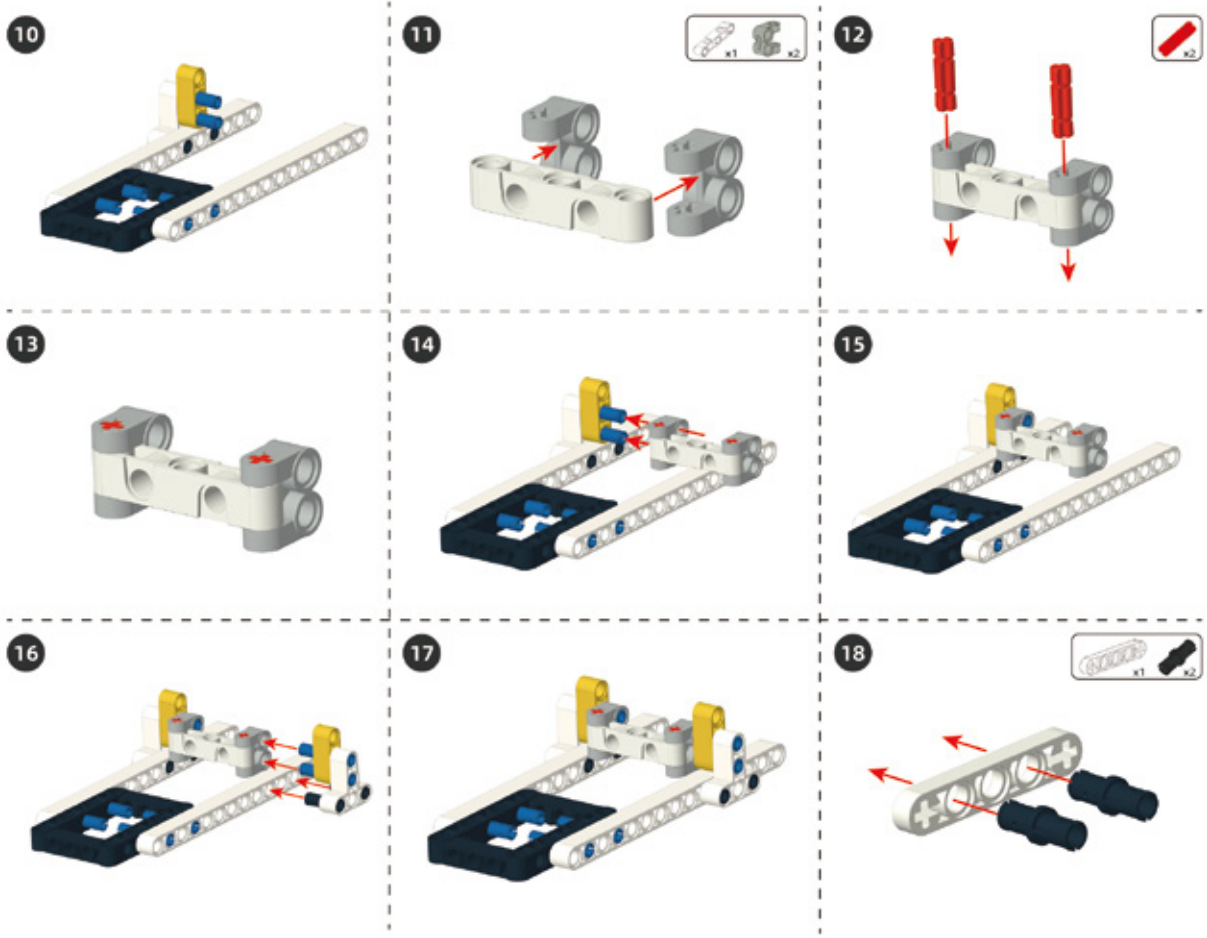
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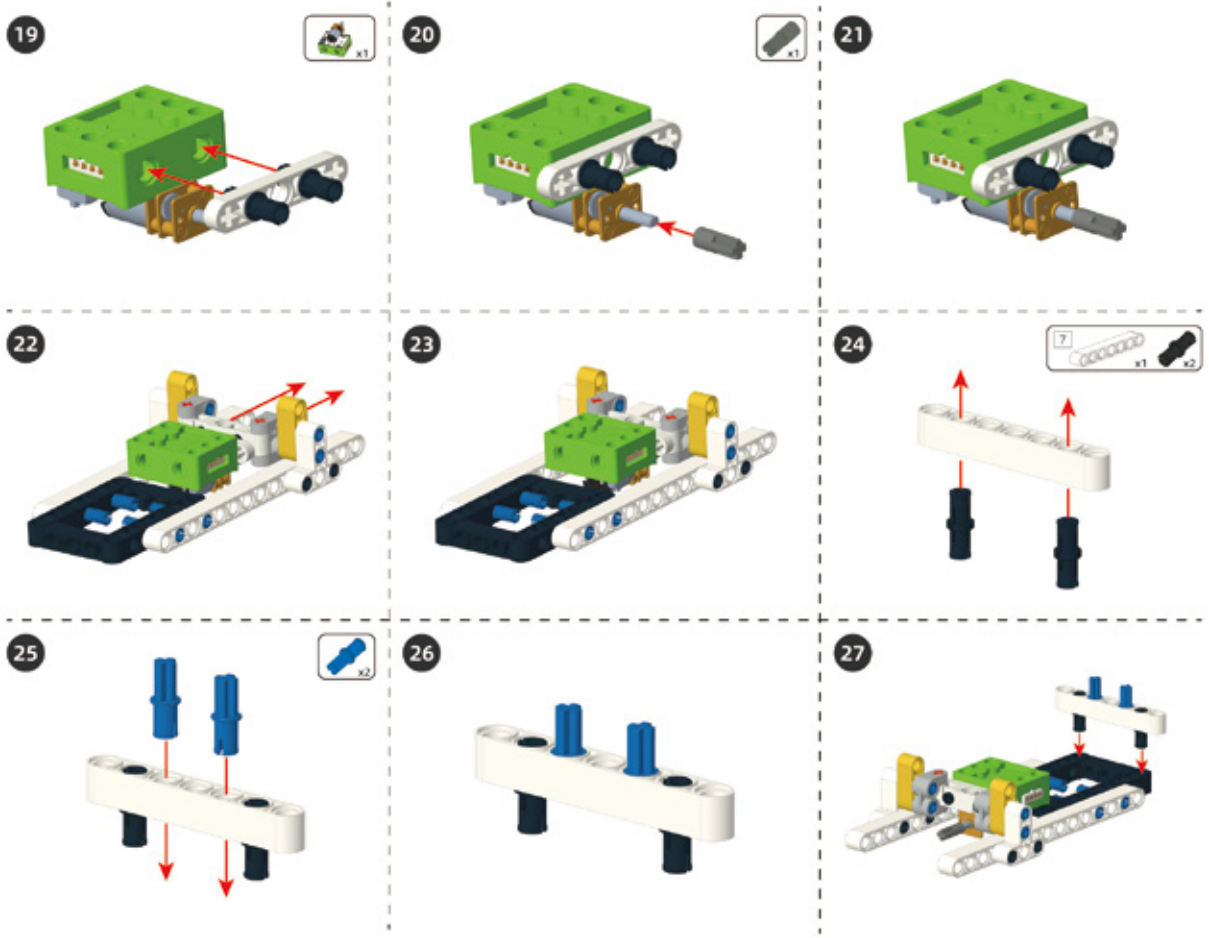
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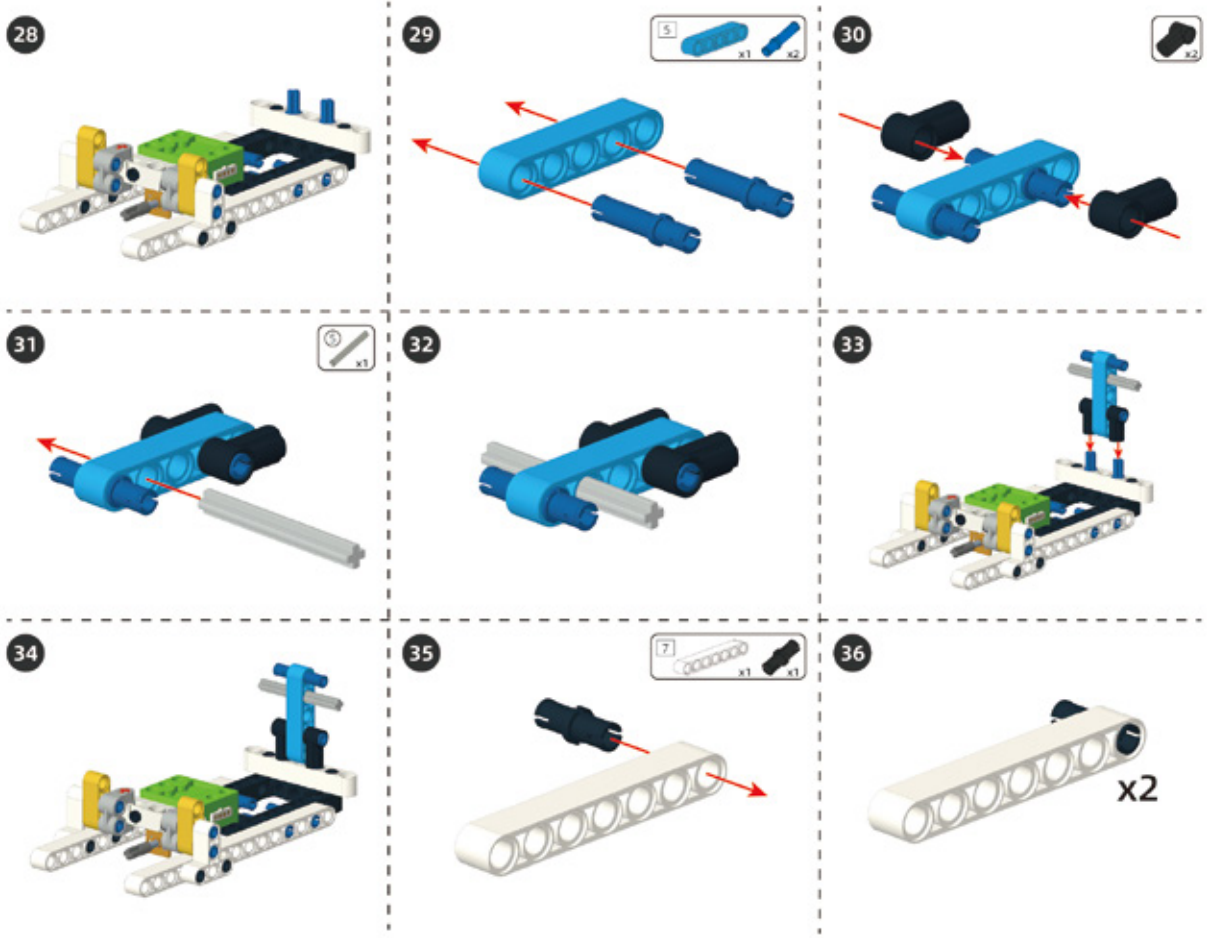
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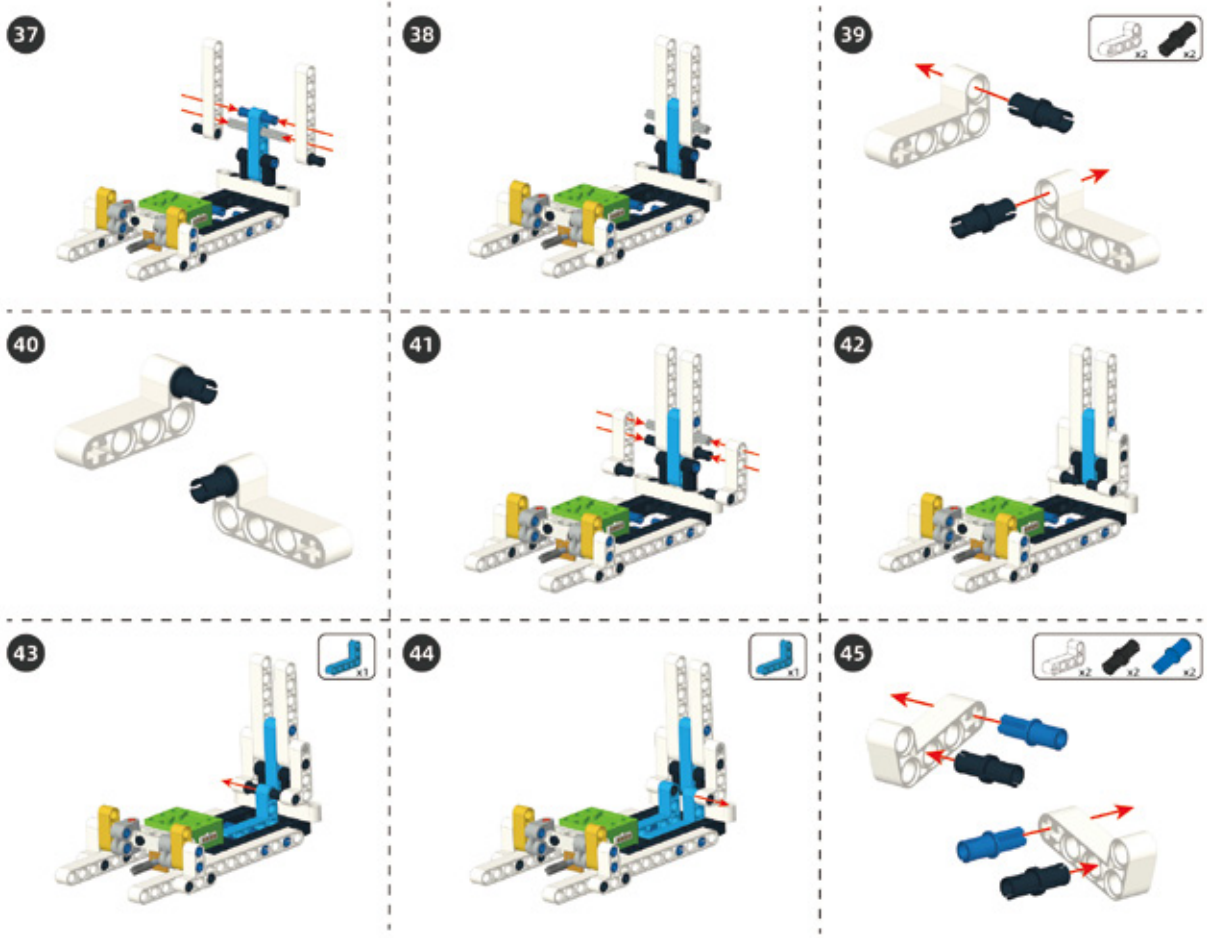
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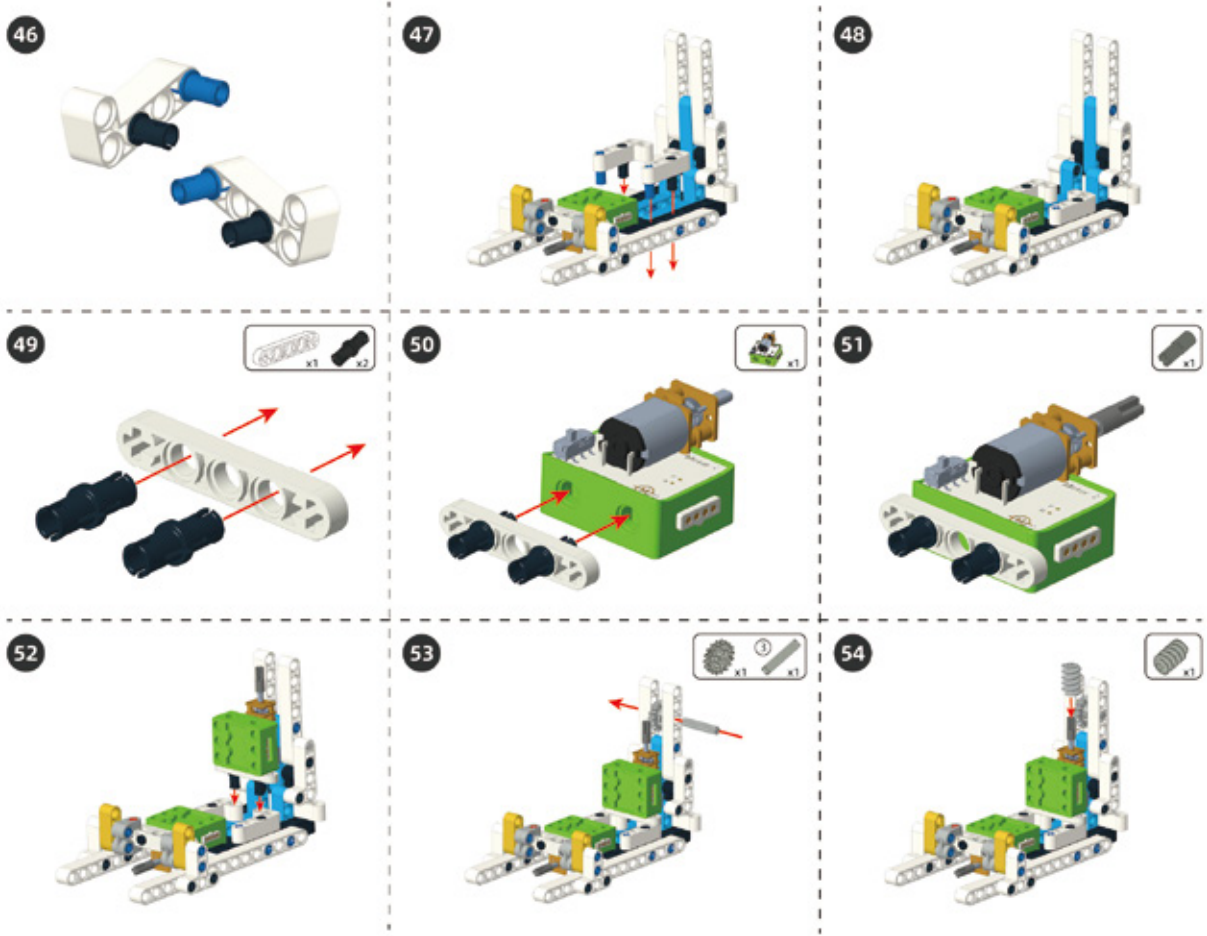
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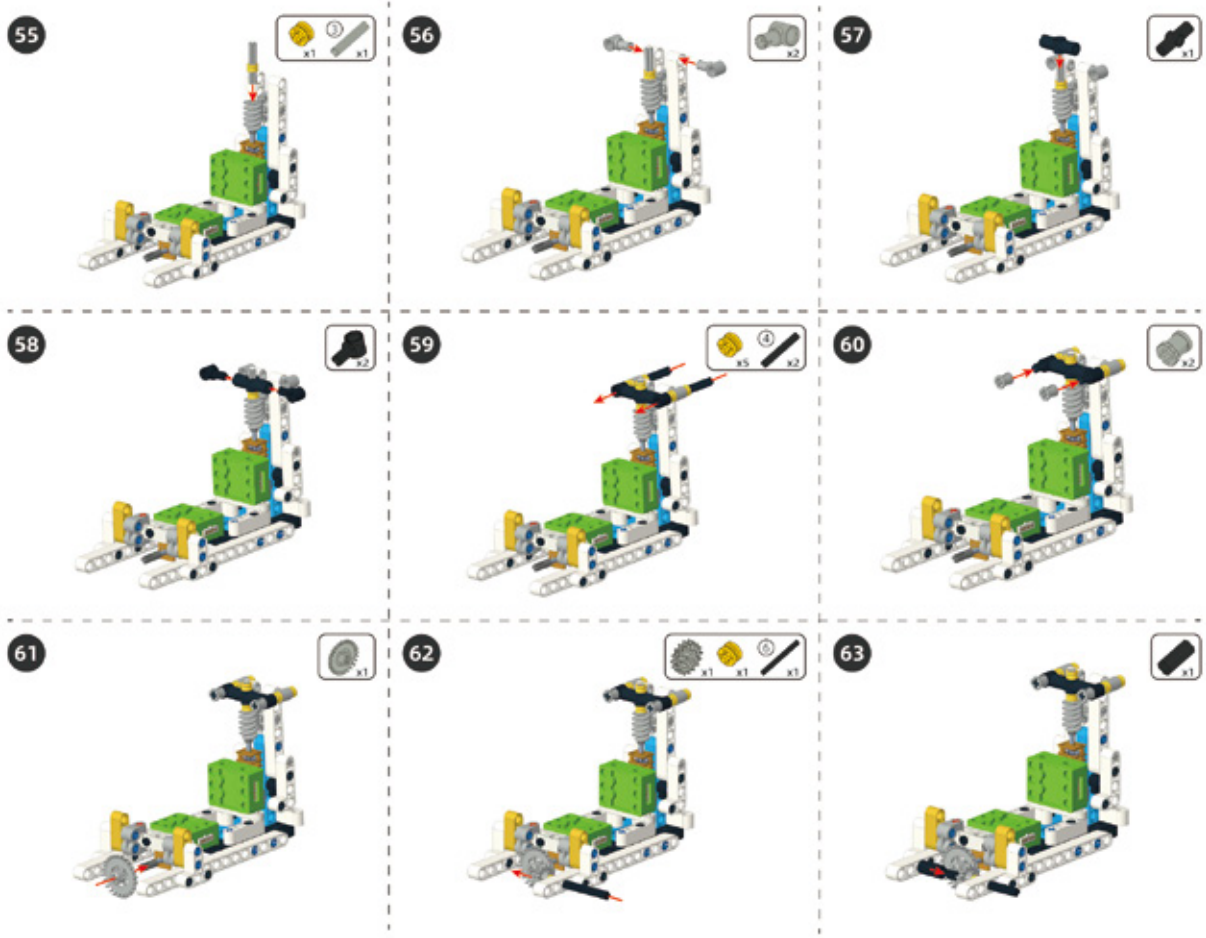
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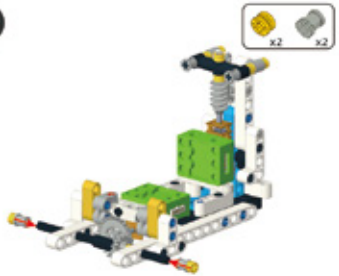

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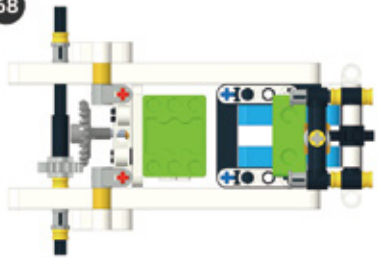

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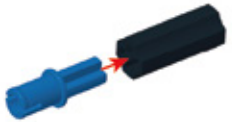

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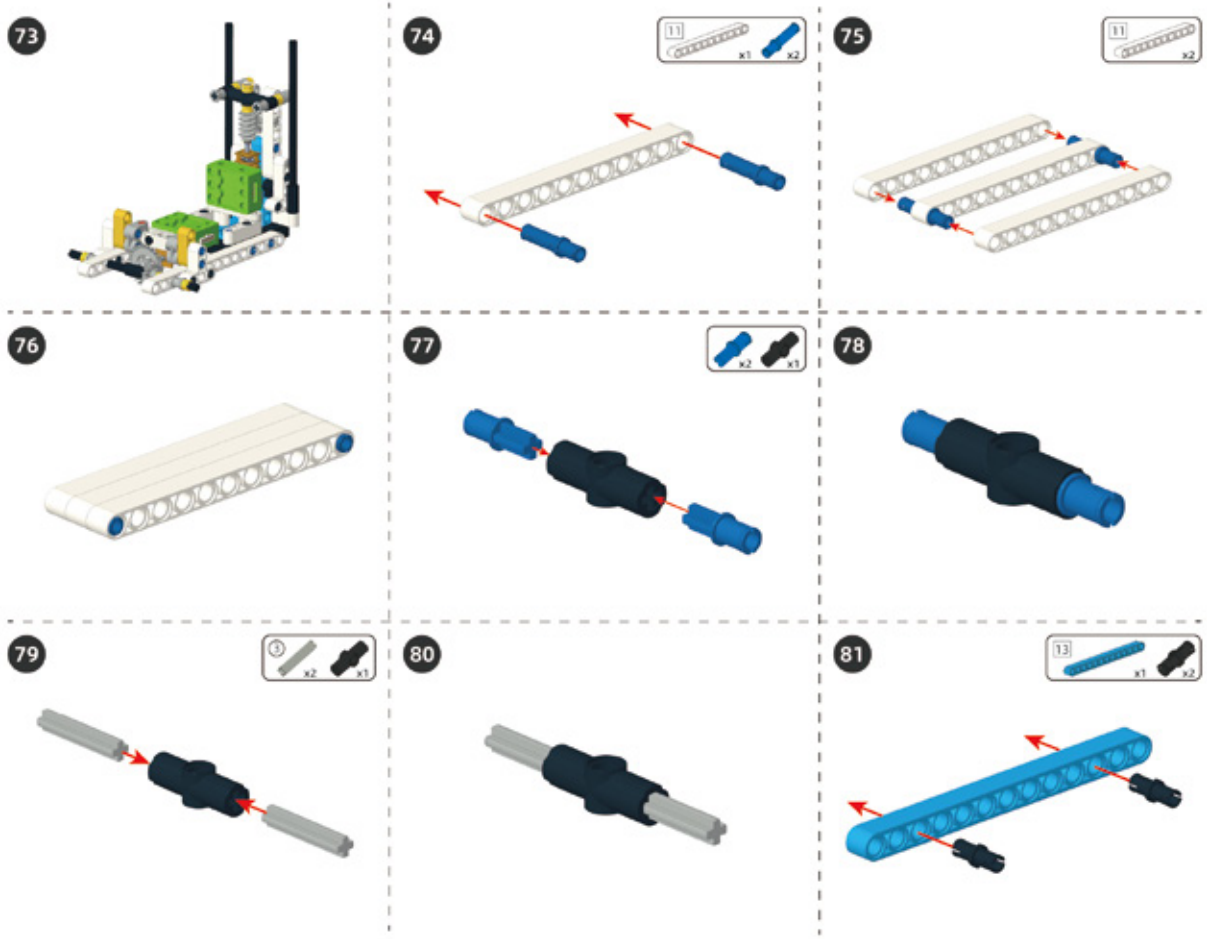
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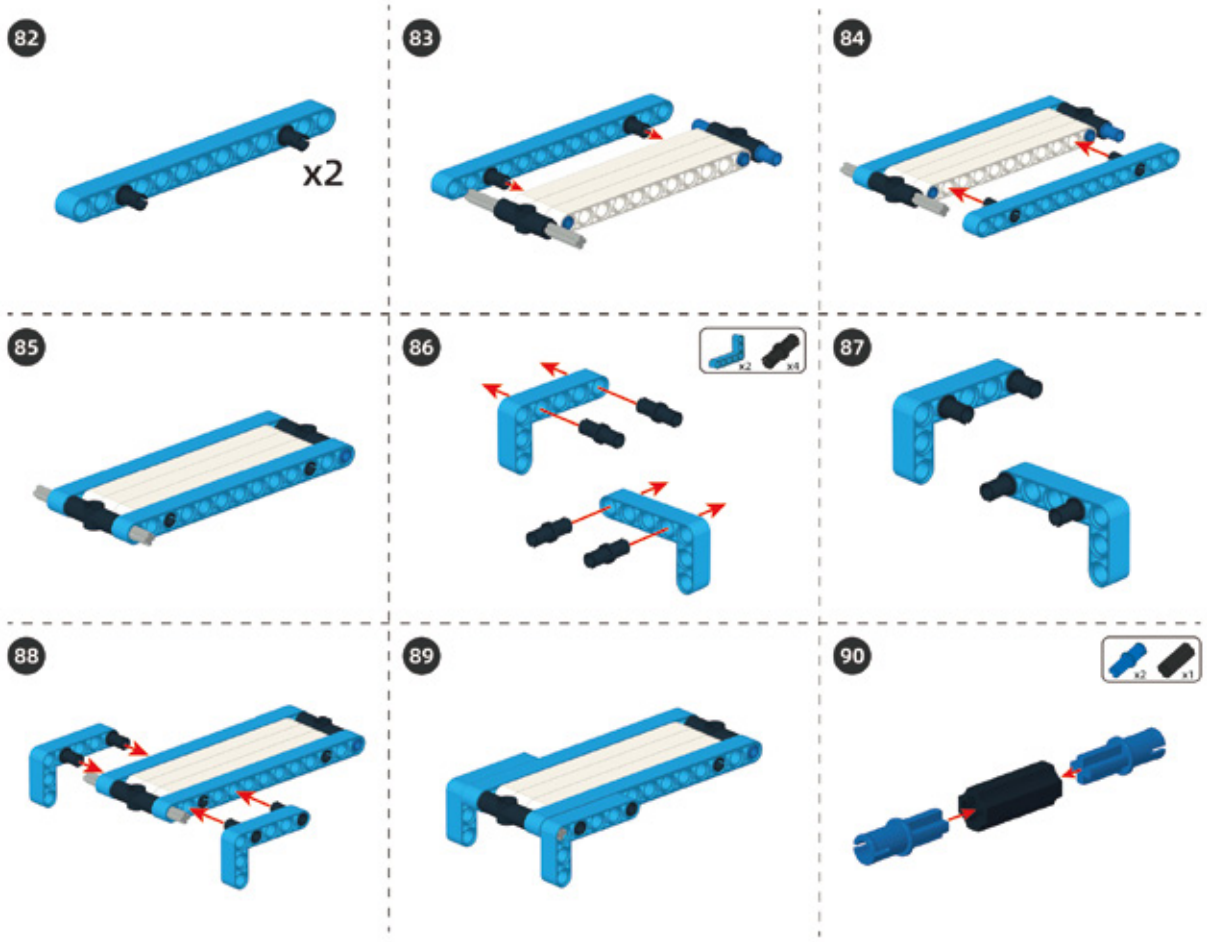
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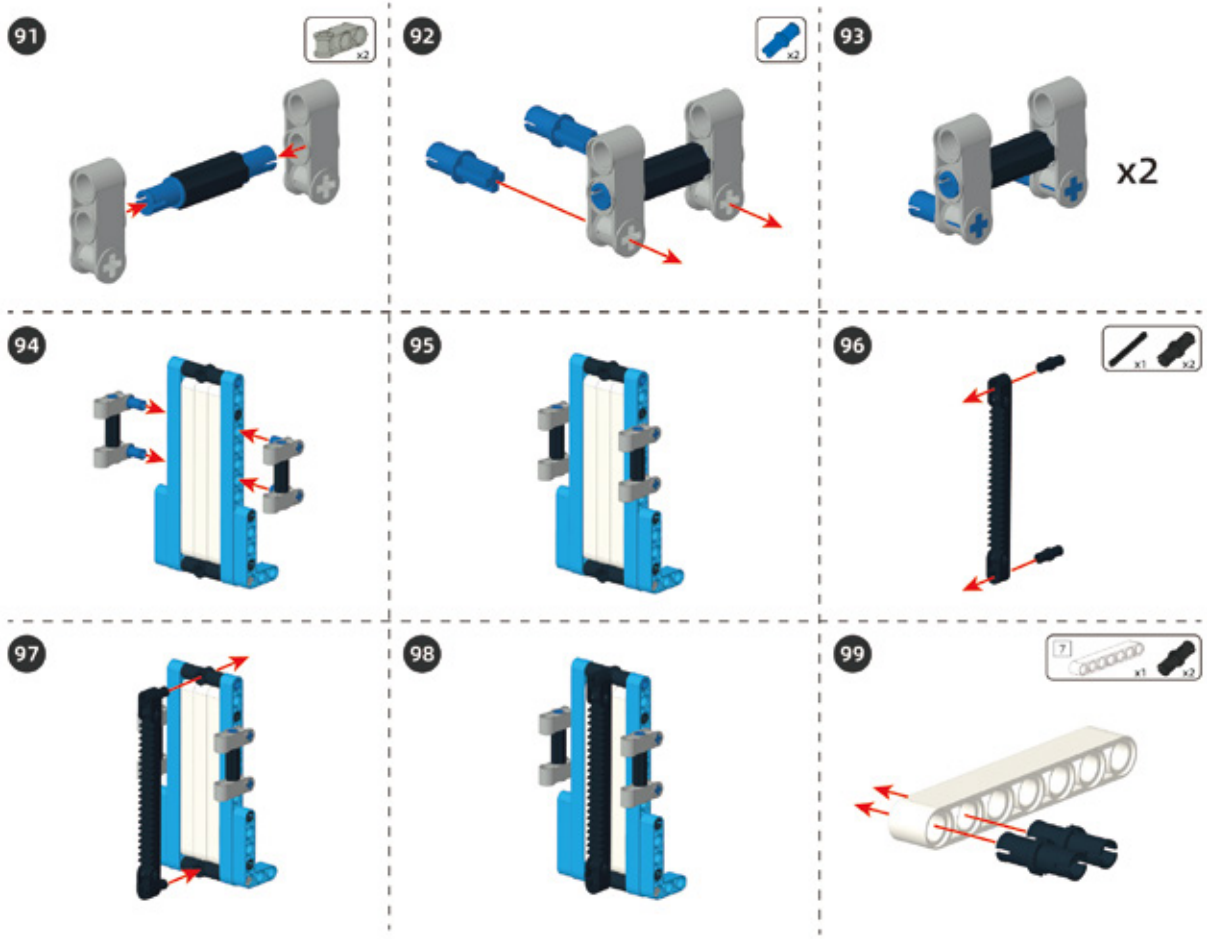
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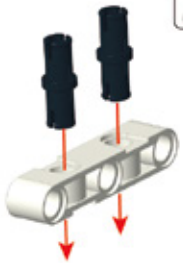

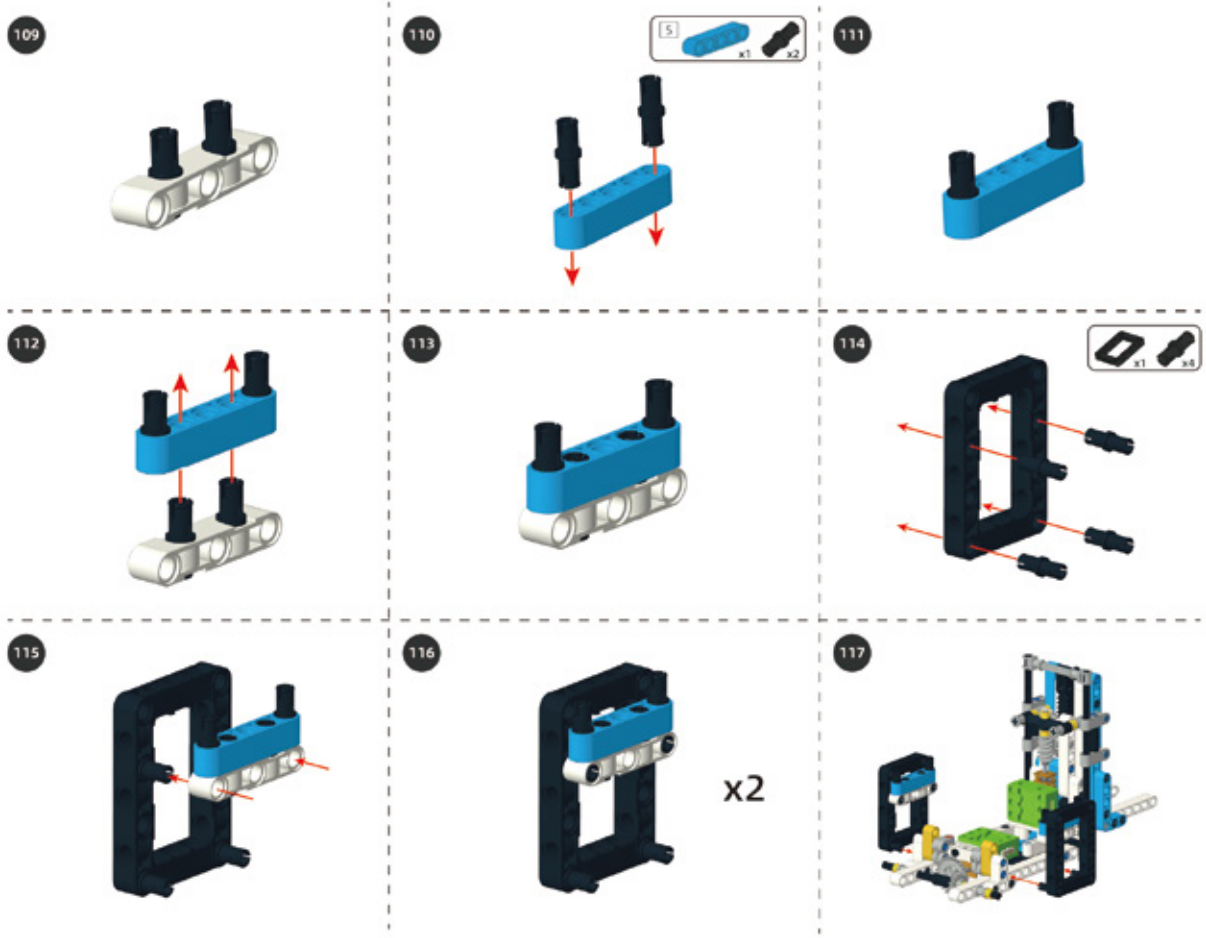
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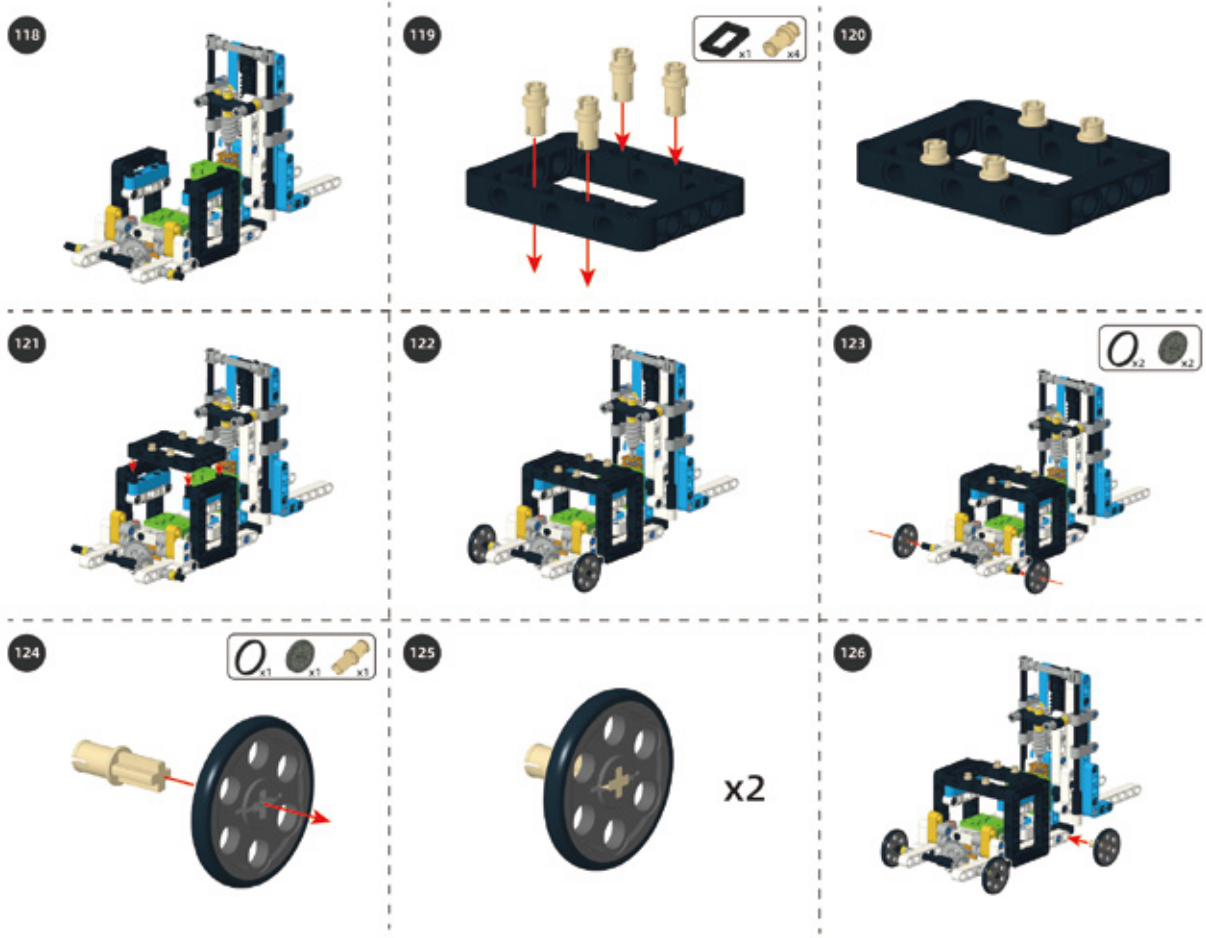
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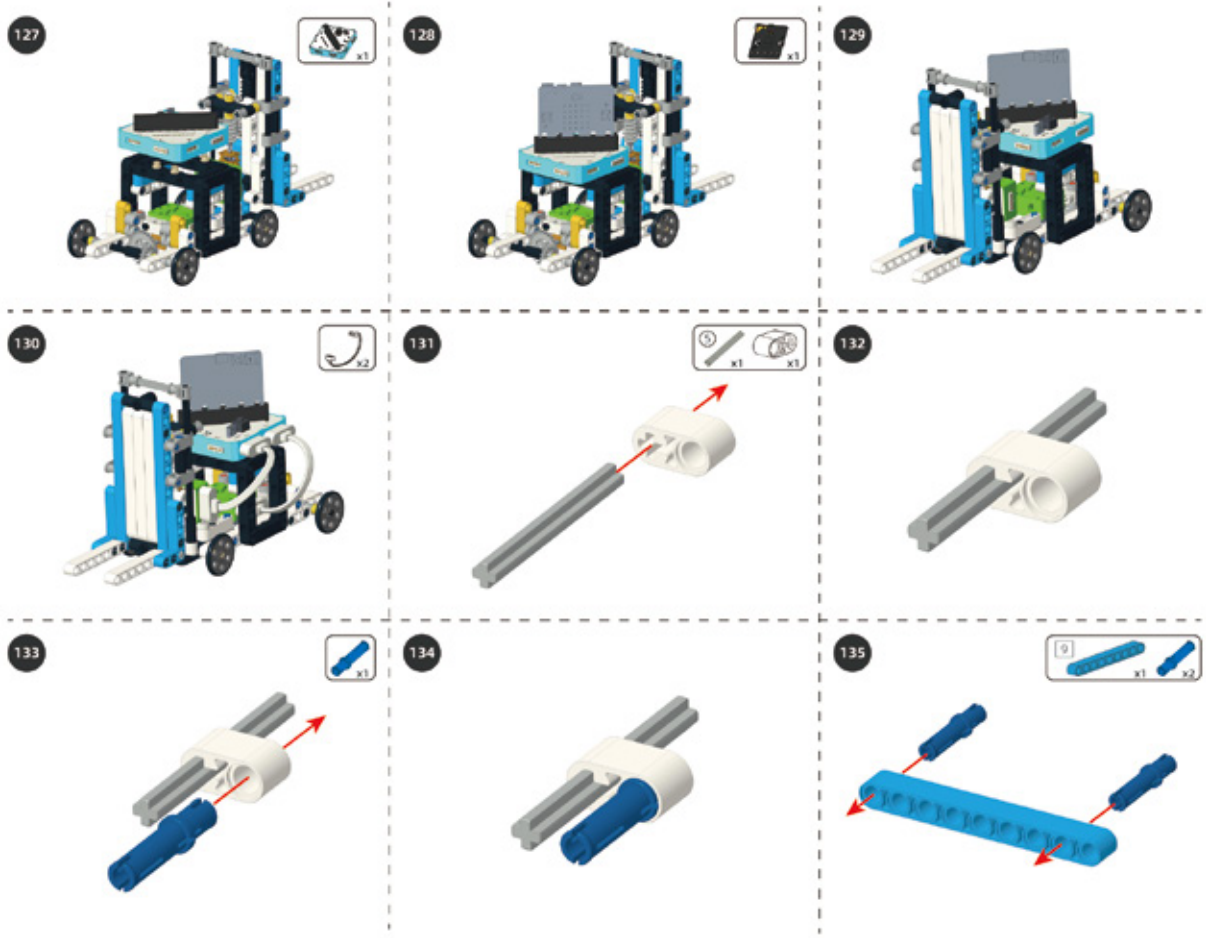
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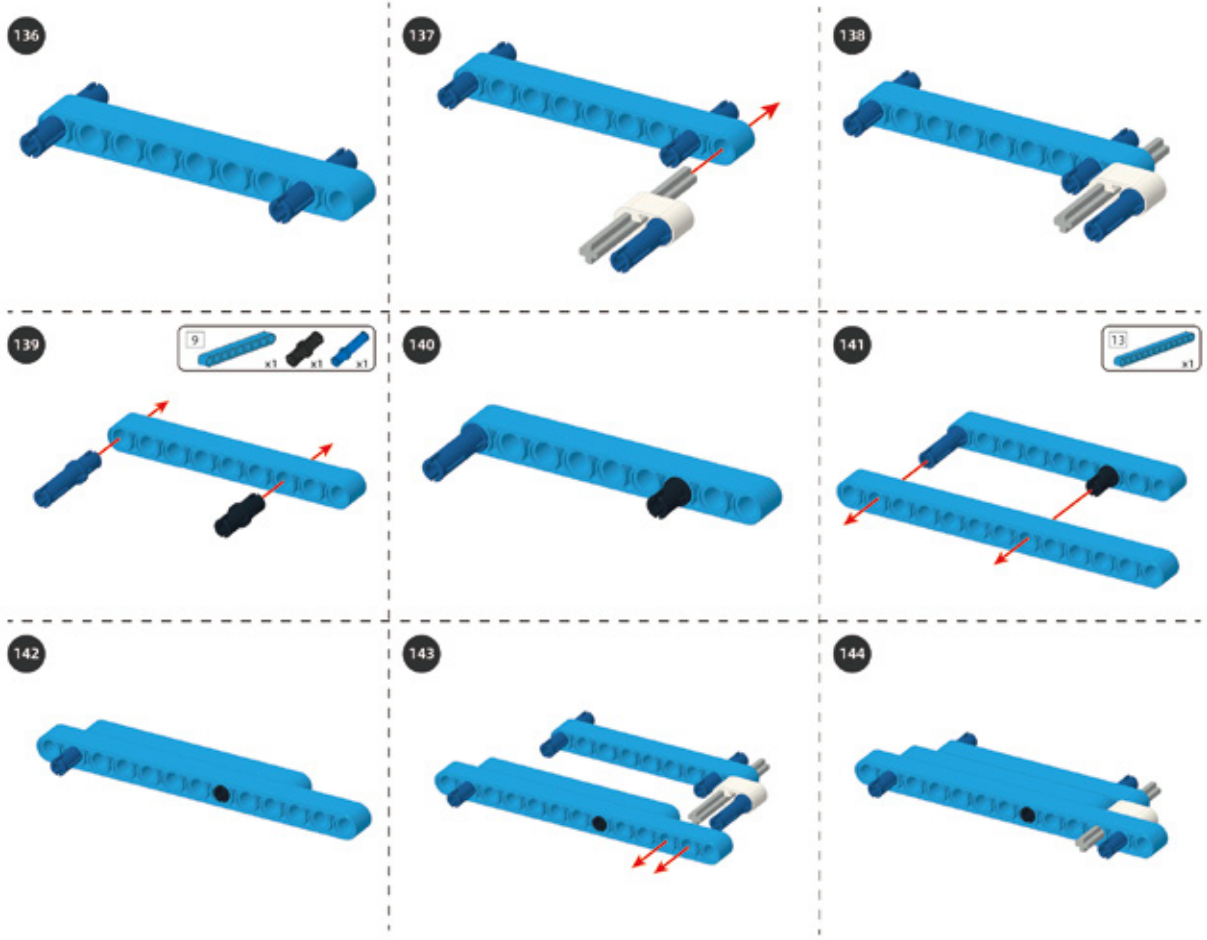
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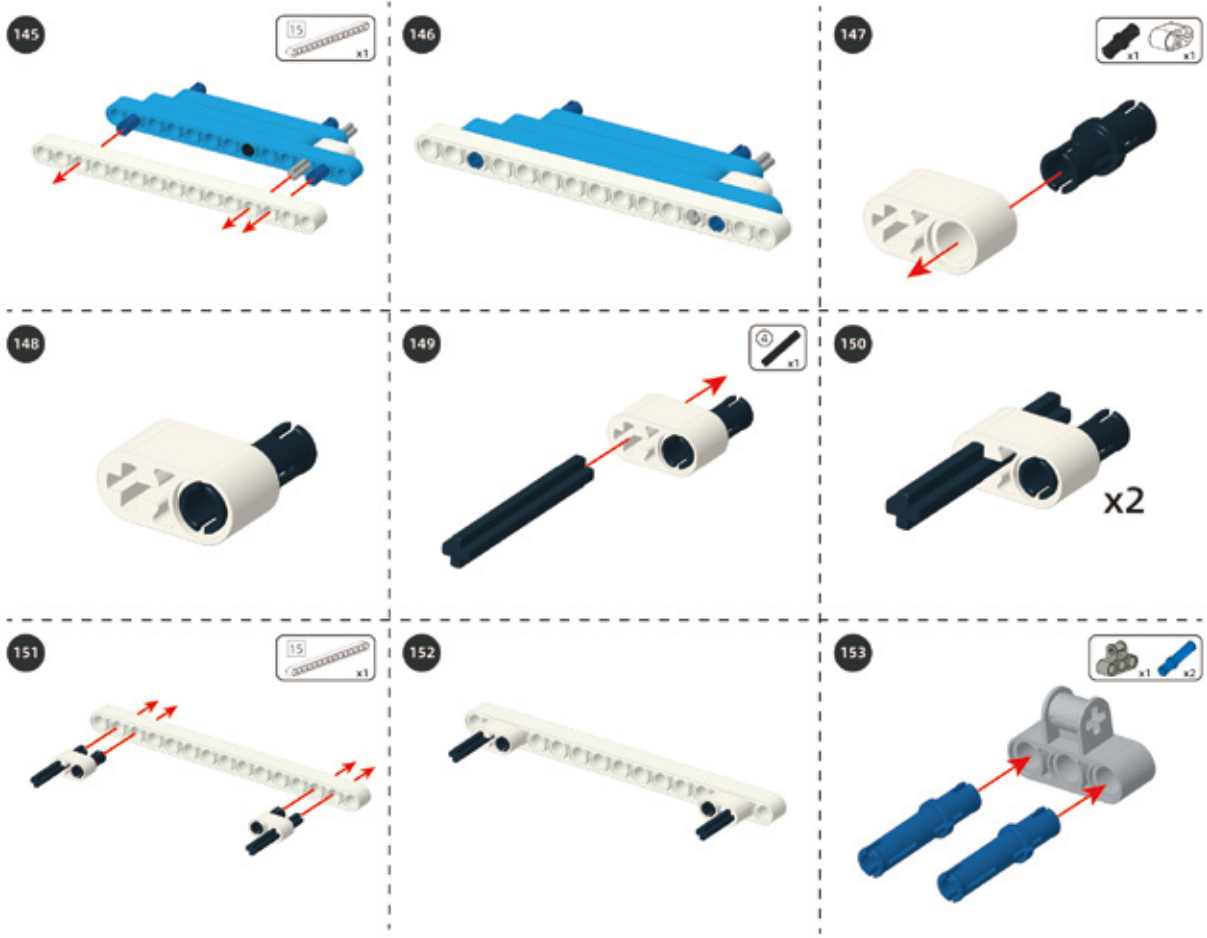
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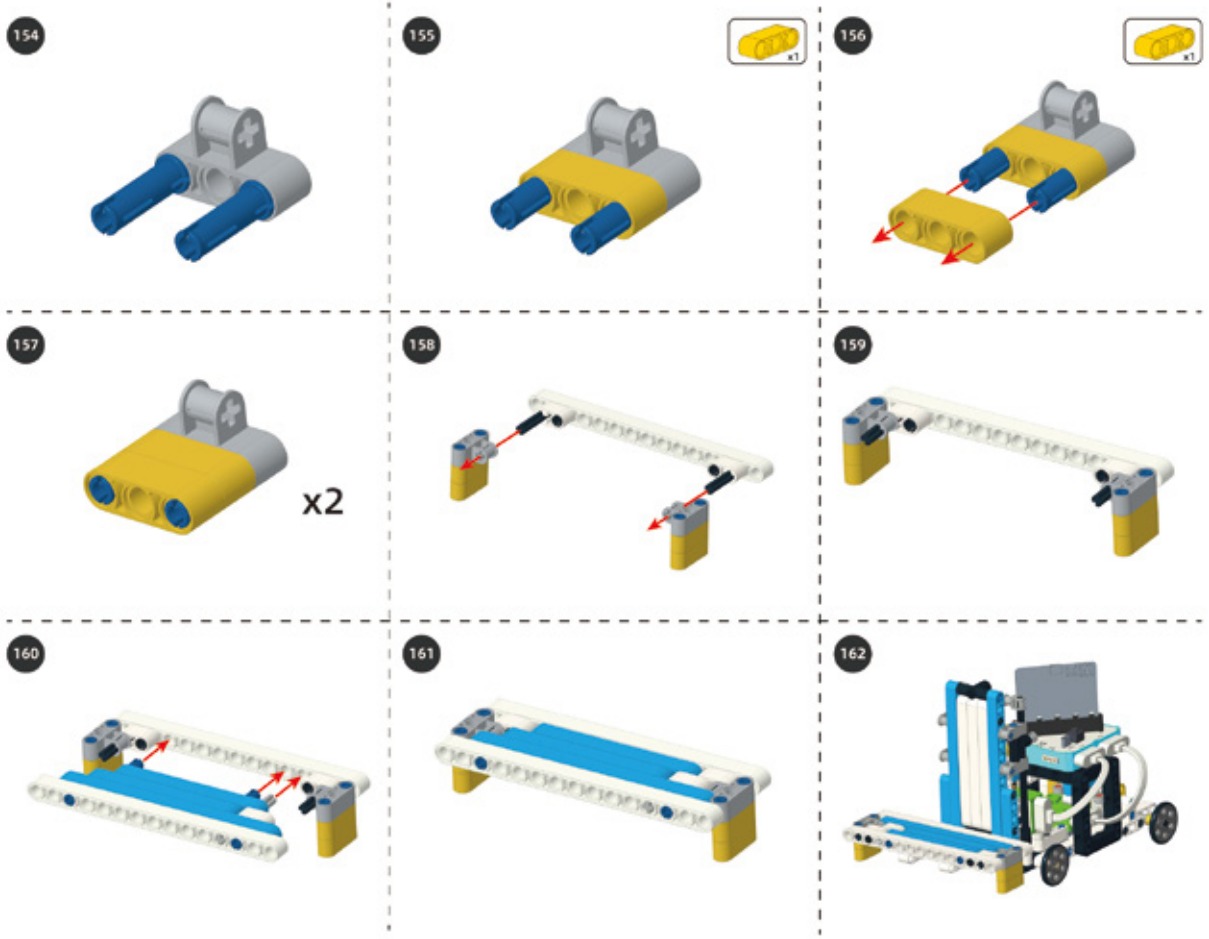
154
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x1
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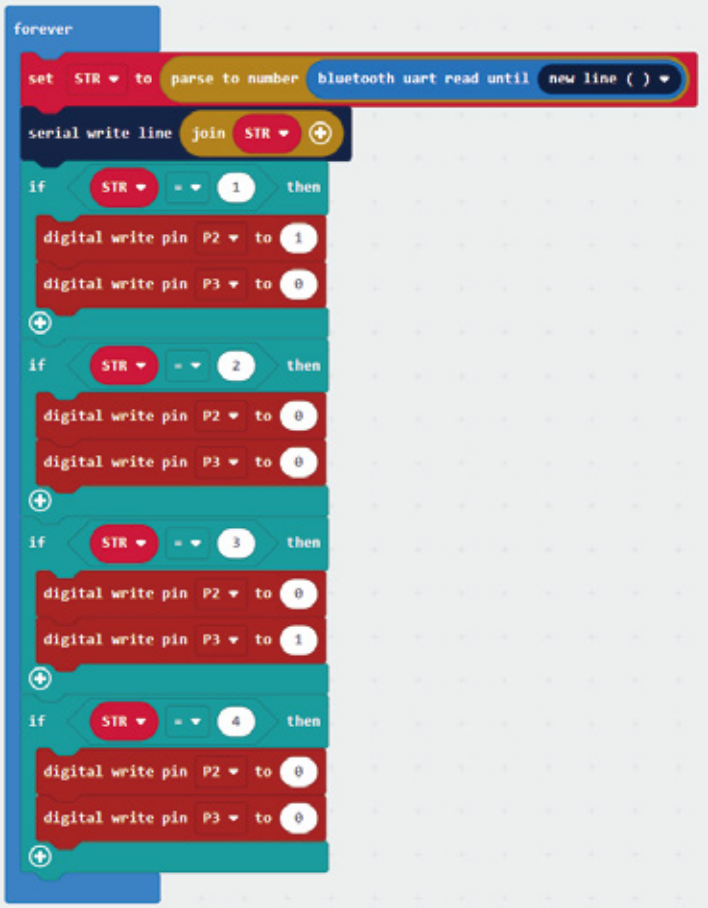
• **Circuit Connection**

Connect the circuit according to the following diagram.

5. Task to Practice

Task Goal: Using the buttons “Up”, “Down”, “Left”, “Right” of the Bluetooth App to control the forklift to go forward, backward, fork up and fork down.

Target Analysis: To complete programming, we need to consider two important parts. The first is that we need to control the movement of the forklift, and the second is to control the up and down of the fork.



1. Forklift movement: Using “Up” and “Down” buttons of the Bluetooth APP to control the forklift to go forward and backward.

Firstly converting the strings we get from App with Bluetooth modules to integers and storing it in variable STR. Assuming that “1” will be sent when pressing button “Up” on App, and “2” will be sent when releasing it. When pressing button “Down” on App, “3” will be sent, and “4” will be sent when releasing it. Here is the program for forklift movement:

2. Fork Movement: Using buttons “Left” and “Right” of the Bluetooth APP to control the fork to go up and down.

Assuming that when pressing button “Left” on App, “5” will be sent, and “6” will be sent when releasing it. When pressing button “Right” on App, “7” will be sent, and “8” will be sent when releasing it. Here is the program for fork movement:

For the complete program, please visit the official website to download: forum.elecrow.com.

6. Game Interactions

Invite your friends to have a goods-loading game with your forklift!

You can prepare some cuboid blocks with supports under them which will make sure your fork can lift the blocks up. And then set a destination to store the goods.

Game Rules: Use the Bluetooth app to control the forklift, and the person who moves the most goods in five minutes will win the game.

7. Brainstorming

We use two DC motors and worms in the forklift and lawn mower, which makes their structure similar. For the forklift, we also use racks to control the up and down of the fork. In our daily life, there are many other machines that can do the lift like the cranes, tower cranes, lift platforms, and so on. And now you can try to use your existing equipment to design your own Bluetooth remote control lifting platform.

Project 12 Dump Truck

1. Learning Goals

1. Know about the application and features of dump truck.
2. Learn the automatic lifting and unloading device of the dump truck.
3. Complete the building and programming for dump truck.

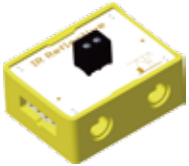
2. Application

In daily life, you may see such a scene: when a dump truck is unloading, the cargo will automatically rise and things will be poured out, which is very convenient and effective. Do you know how a dump truck works?

Now, let us make a dump truck that can unload automatically!

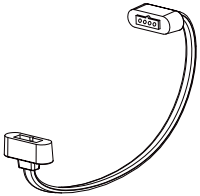
3. Supplies List

• **Electronic Supplies:**

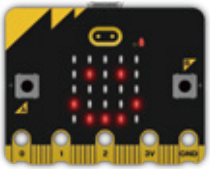


IR Reflective Sensor x1

DC Motor x2



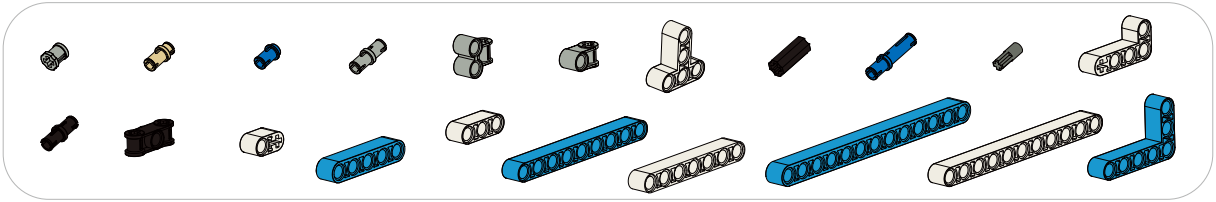
Magnetic Cable x2



Micro:bit x1

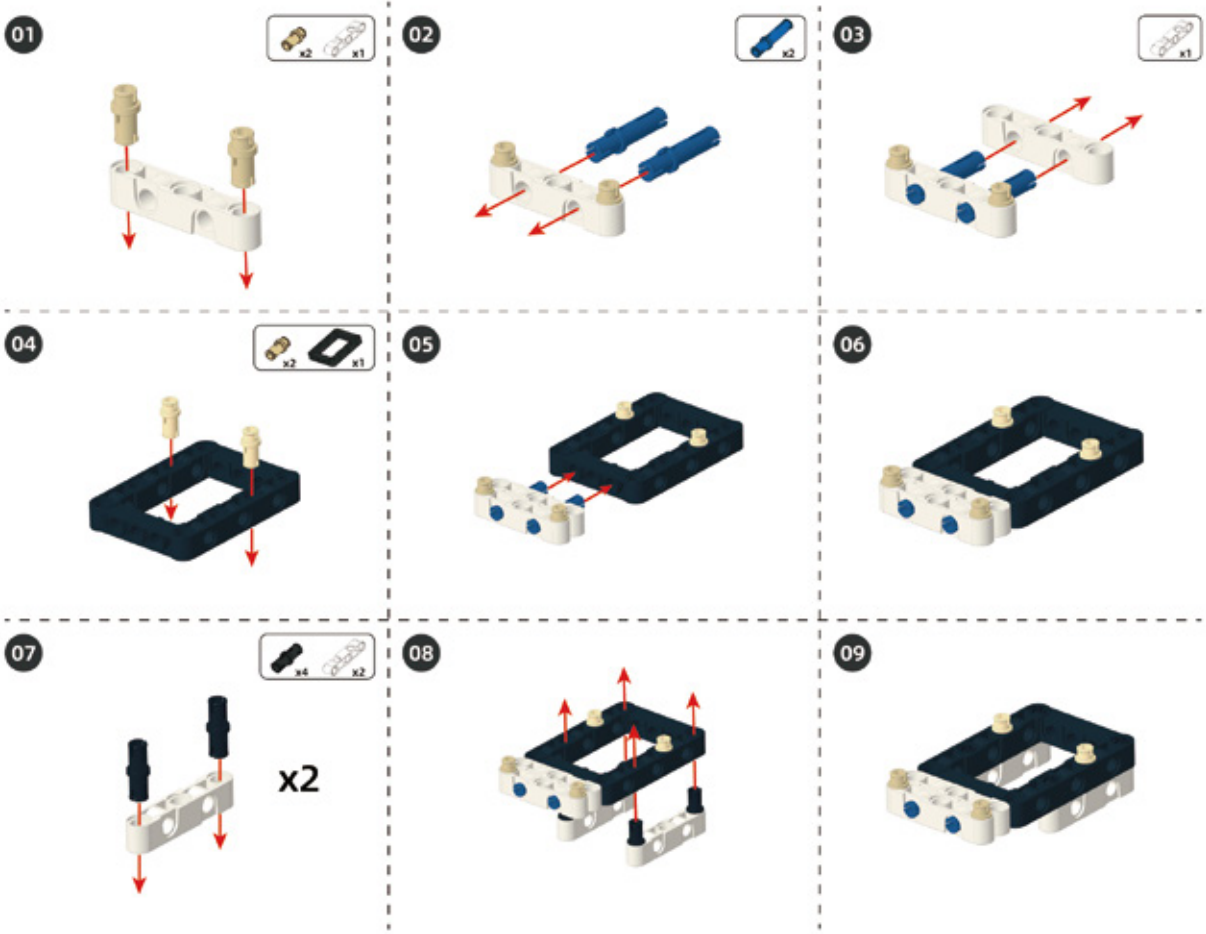
Micro:bit Compatible x1

• **Structure Supplies: LEGO blocks. Choose the blocks according to the assembly diagram.**



4. Model Building

• **Structure Building:**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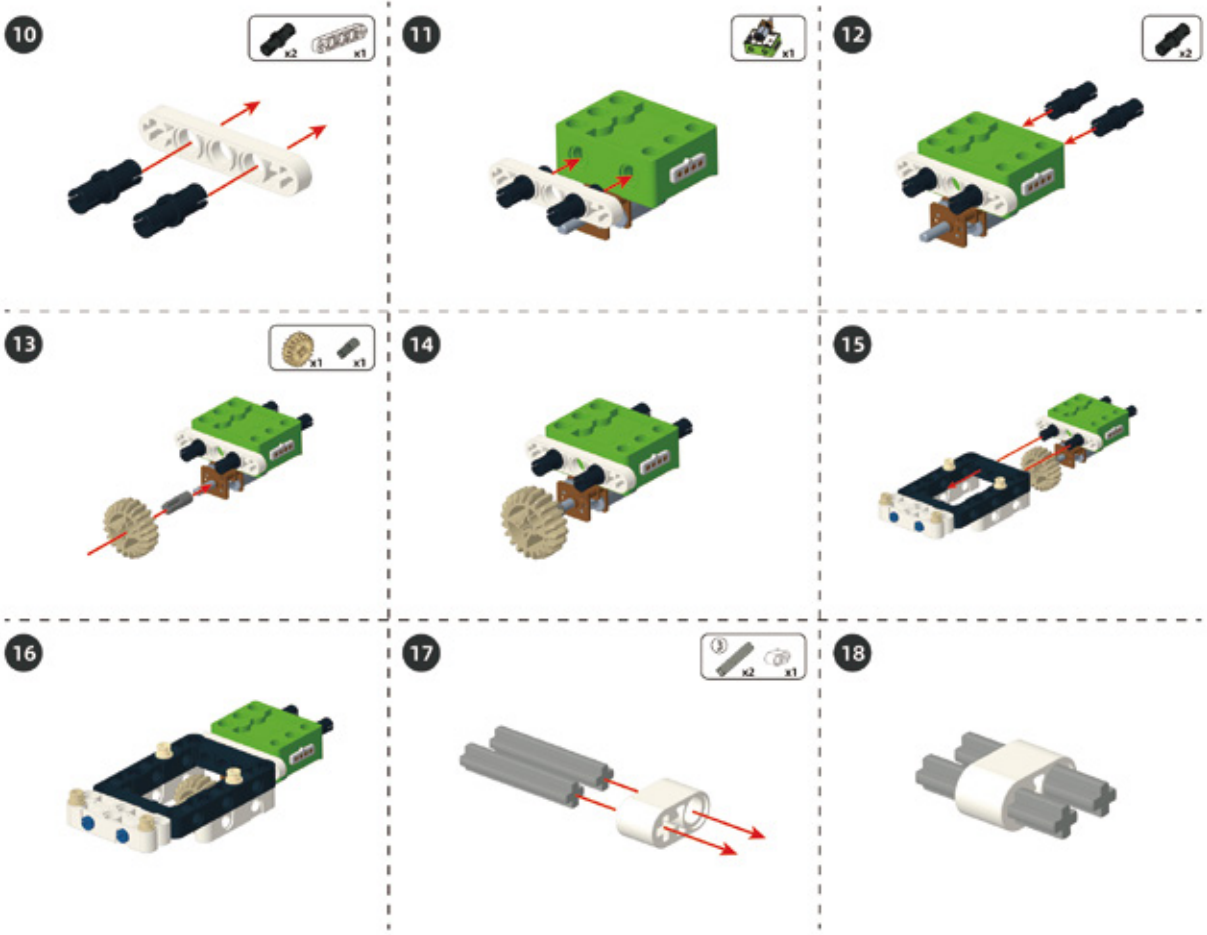
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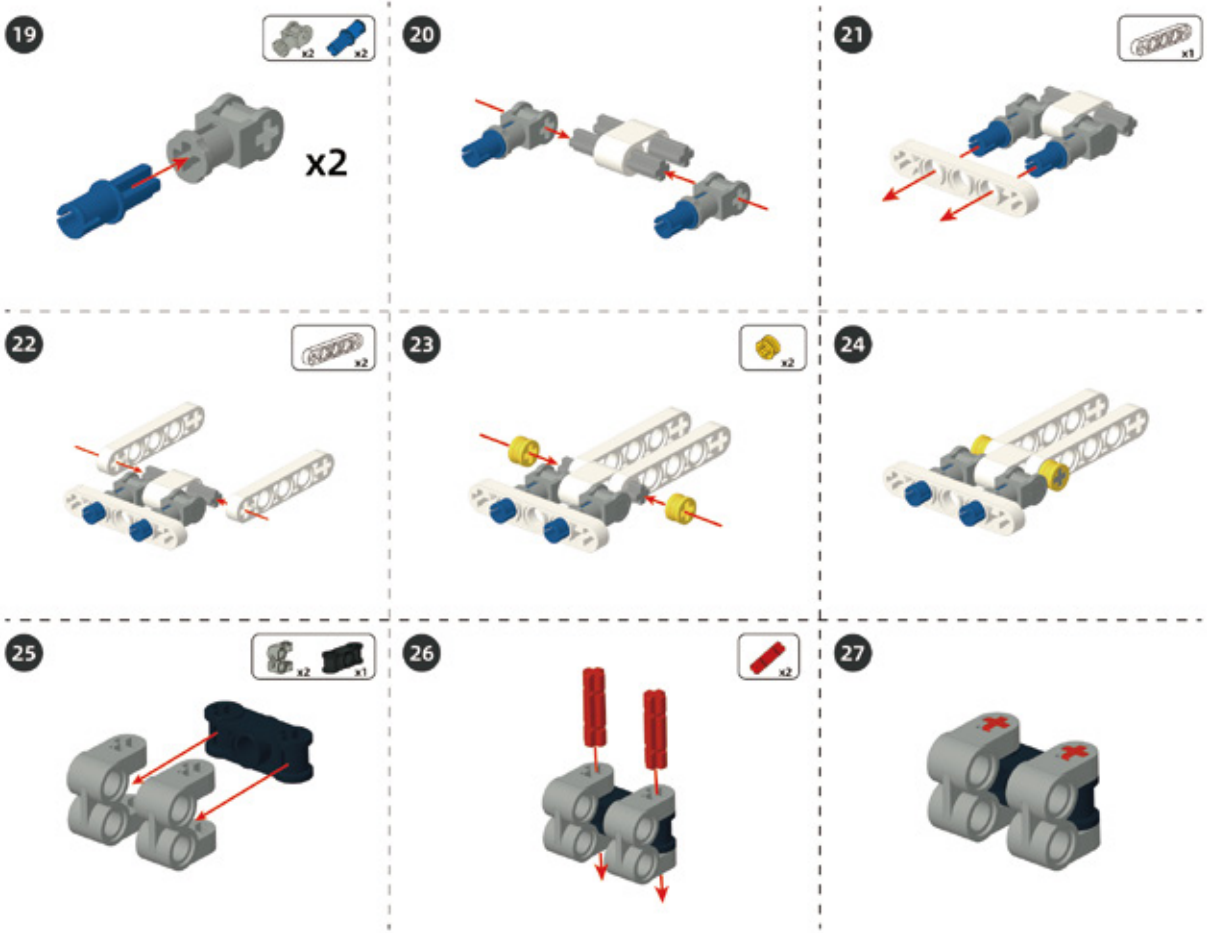
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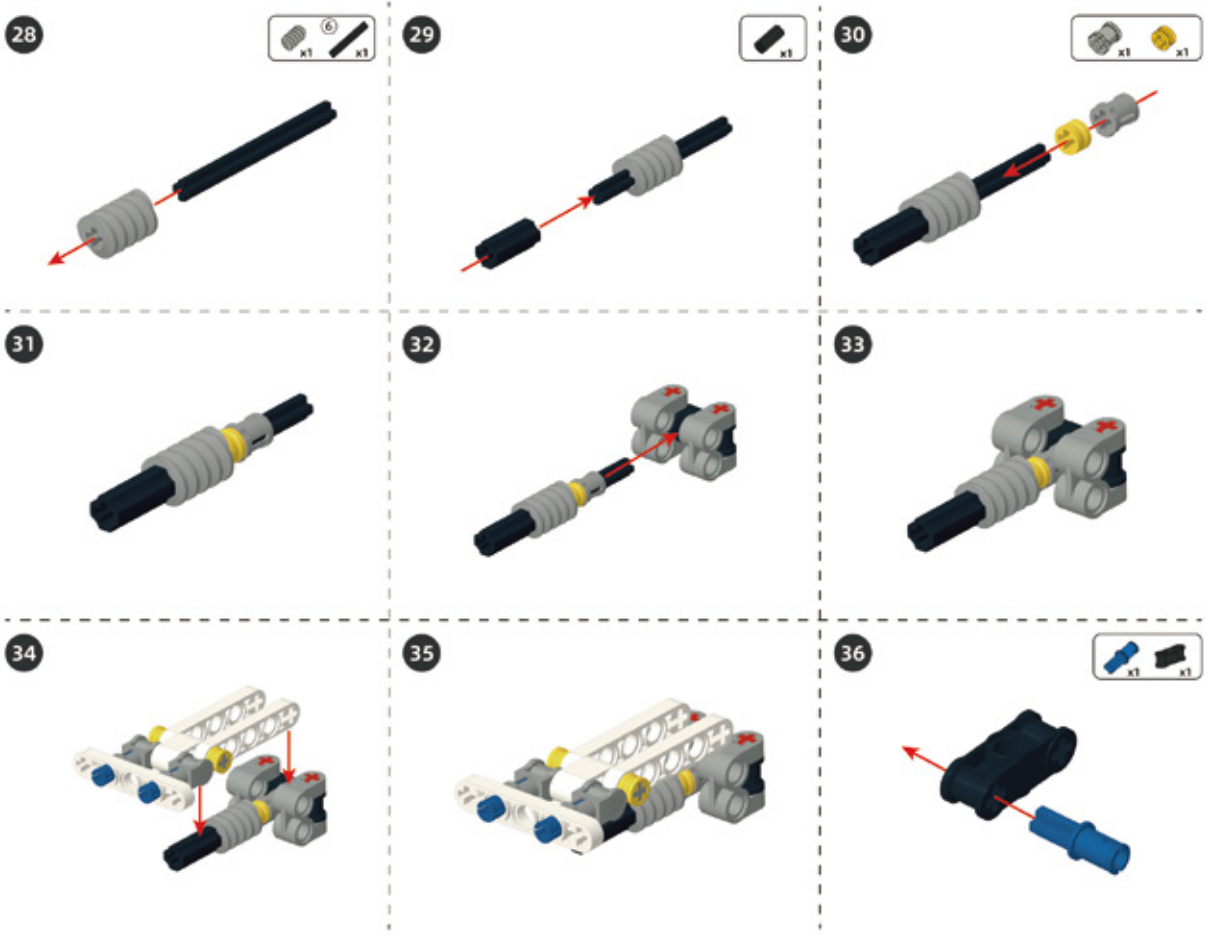
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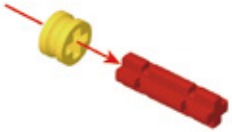

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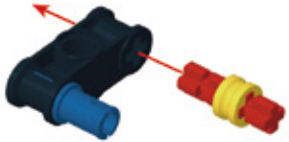

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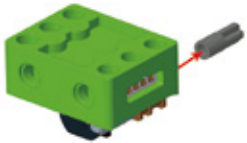

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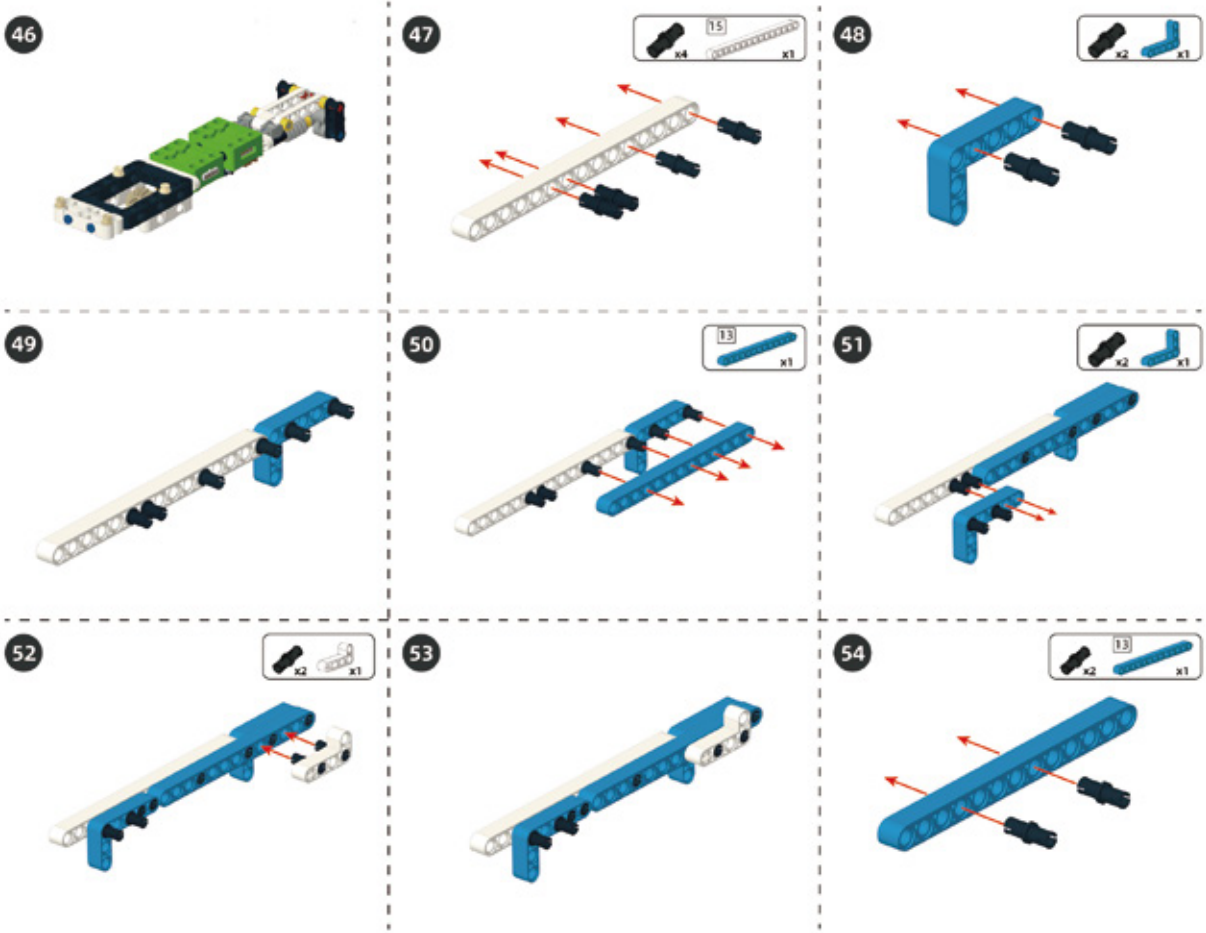
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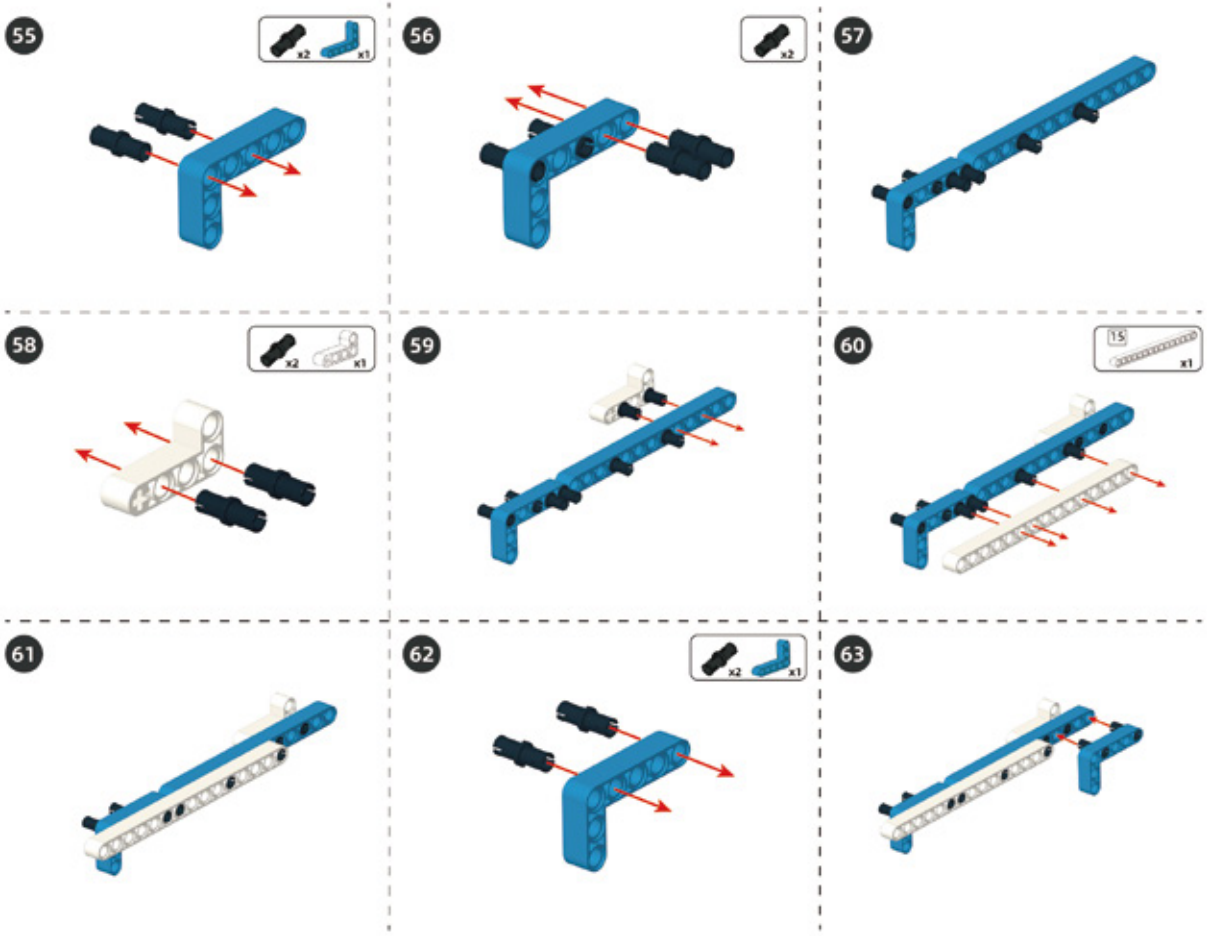
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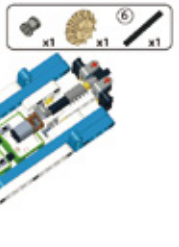

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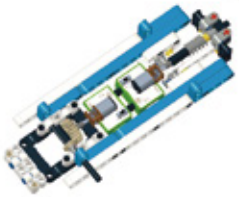

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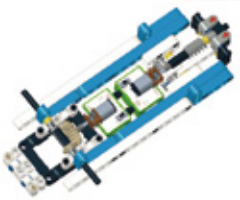

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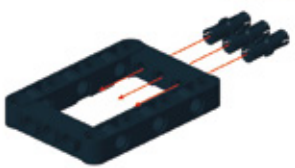

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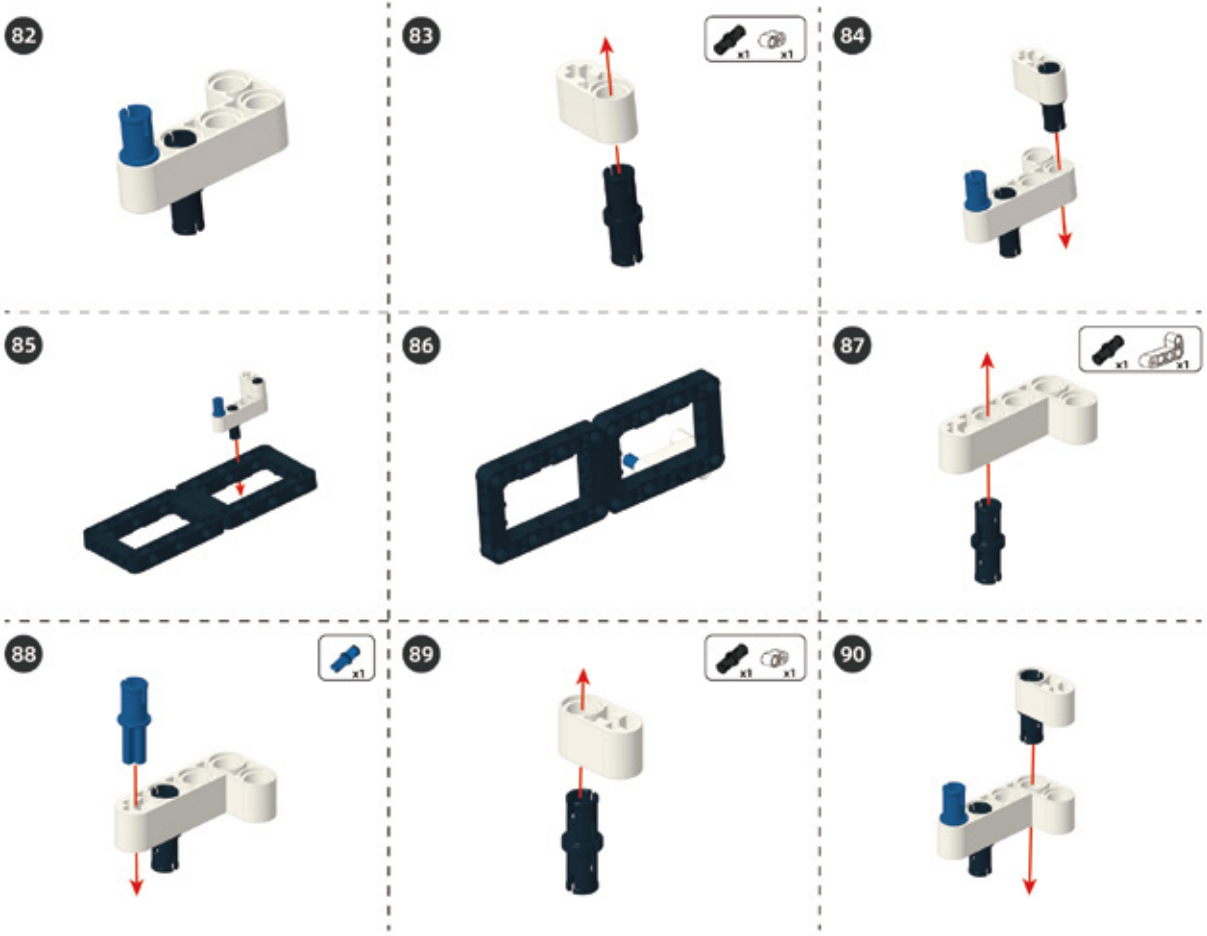
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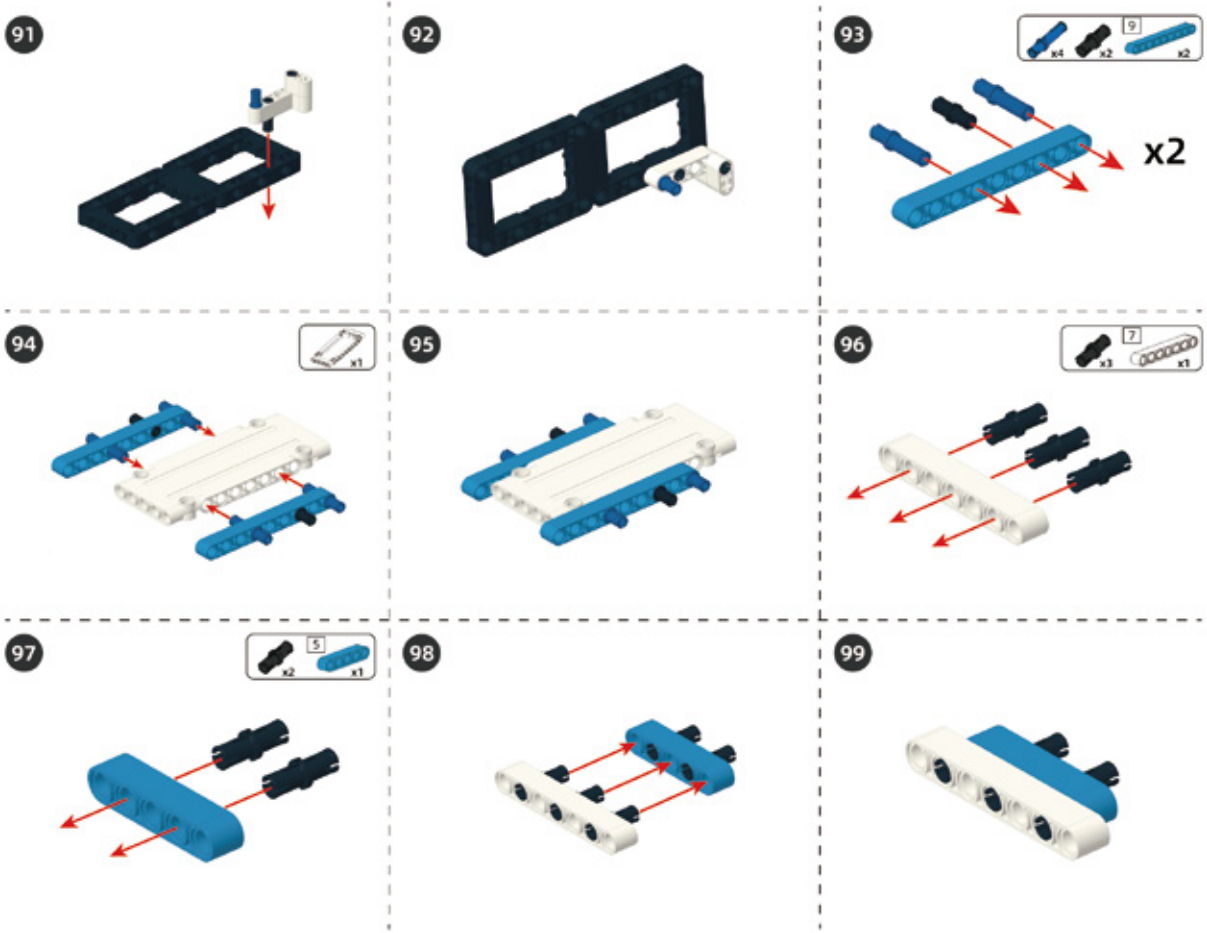
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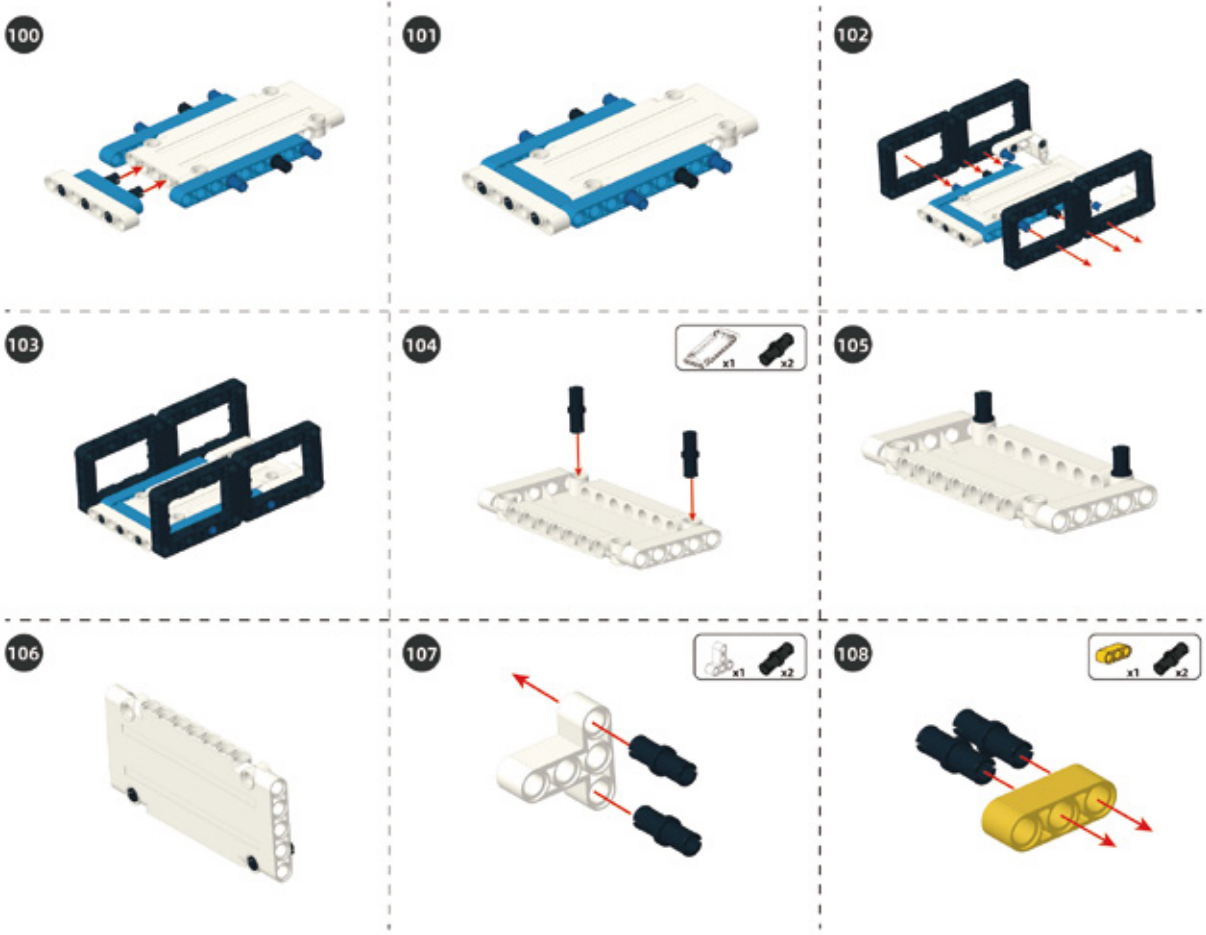
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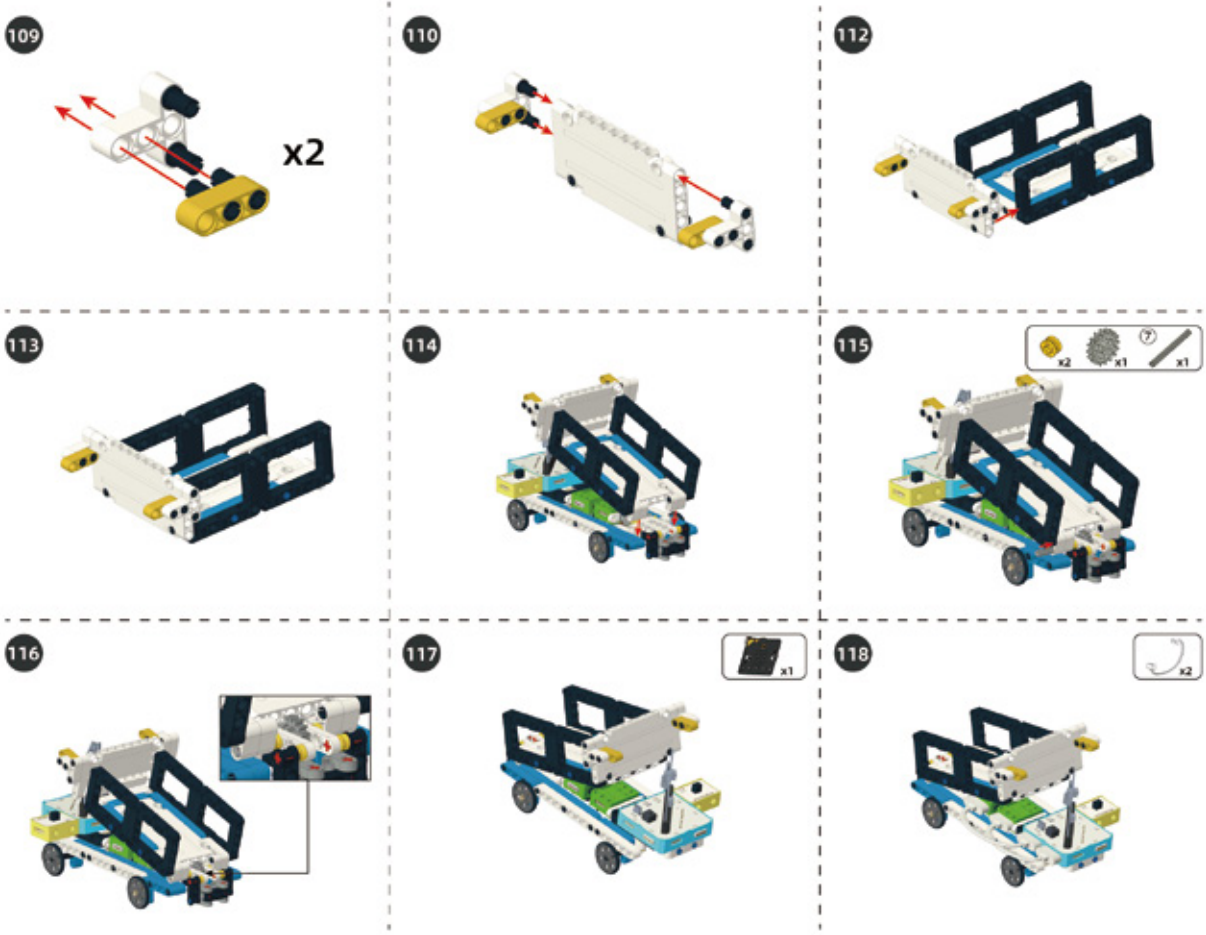
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x1
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x1
118
x2

• Circuit Connection

Connect them according to following circuit diagram.

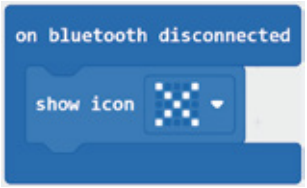
5. Task to Practice

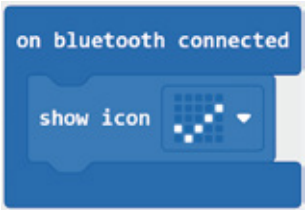
Task Goal: Control dump truck to move forward and backward and control the cargo to rise and fall with Bluetooth app.

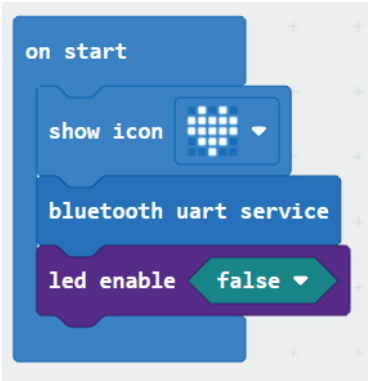
1. Control dump truck to move forward and backward with up and down keys.
2. Control cargo to rise and fall with left and right keys.
3. Control cargo to completely fall with key "A", and the IR reflective sensor to check the landing position of cargo.

Task Analysis: Program includes two parts: one is used for moving forward and backward of dump truck; the other is for unloading stuffs automatically.

• Bluetooth initialization Settings



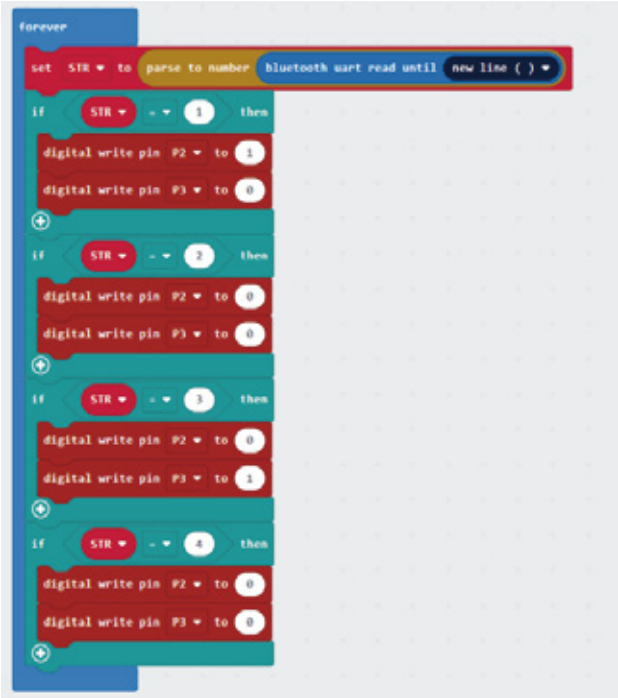




• Moving forward and backward

Control it with up and down keys on the Bluetooth app.

Up	Press to send ' 1 ' , release to send ' 2 '
Down	Press to send ' 3 ' , release to send ' 4 '



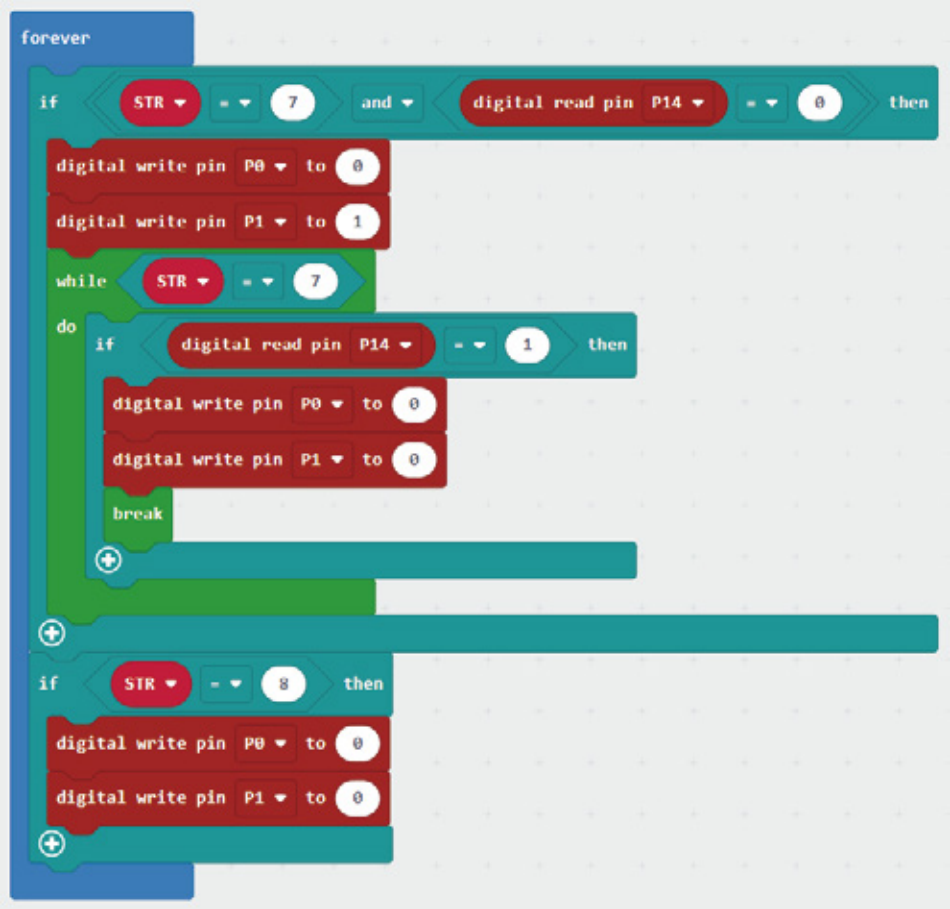
Unloading: includes two parts

1. Control the cargo to rise and fall with left and right keys on the Bluetooth APP.

Left	Press to send ' 5 ' , release to send ' 6 '
Right	Press to send ' 7 ' , release to send ' 8 '

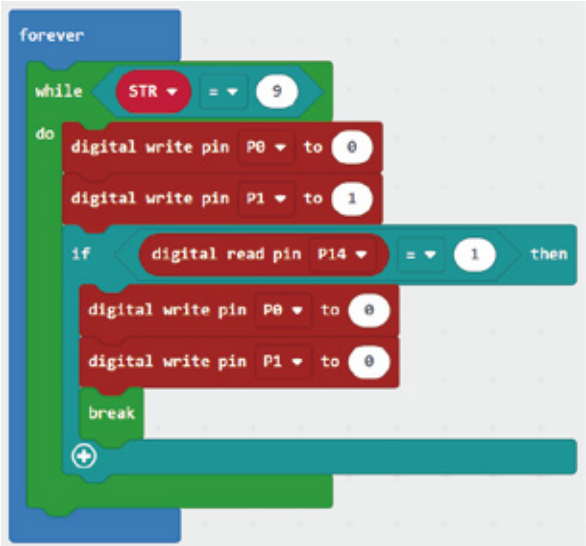
Press the left button, receive the data "5" from the Bluetooth uart port, then the cargo rises; release the left button, receive the data "6" from the Bluetooth uart port, then the cargo stop rising.

We need to meet both conditions at the same time. Firstly, press the right button to receive "7" from the Bluetooth uart port; secondly, when the IR reflective sensor does not detect the object, the level of P14 is 0, and the cargo falls. When the IR reflective sensor detects an object, the level of P14 will be 1, and the cargo will stay. Similarly, release the right button to receive "8" from the Bluetooth uart port, and then the cargo stop falling.


forever
if STR = 7 and digital read pin P14 = 0 then
digital write pin P0 to 0
digital write pin P1 to 1
while STR = 7
do
if digital read pin P14 = 1 then
digital write pin P0 to 0
digital write pin P1 to 0
break
if STR = 8 then
digital write pin P0 to 0
digital write pin P1 to 0

2. Combine the IR reflective sensor with key “A”, when the status of cargo is rising, control the cargo to completely fall with just one pressing.

A	Press to send ‘ 9 ’ , release to send ‘ 10 ’



The cargo will fall only when you press the key “A” to receive the “9” from the Bluetooth uart port; if the IR reflective sensor detects an obstacle during the fall of the cargo, the level of P14 will be 1, and the cargo will stop fall and jump out of the loop.

For the complete program, please visit the official website to download: forum.elecrow.com.

6. Game Interactions

Invite your friend to join the game “cargo handling”!

Rules: two participants needed, one as the loader and the other as the trucker. The trucker uses the Bluetooth App to control the dump truck to transport the goods to a specific location and unload the goods, and then control the dump truck back to its original position through the Bluetooth App. After completing the first round of the game, switch roles to see who complete the game in the shortest time. To increase the difficulty and fun of the game, you can add some obstacles on the road.

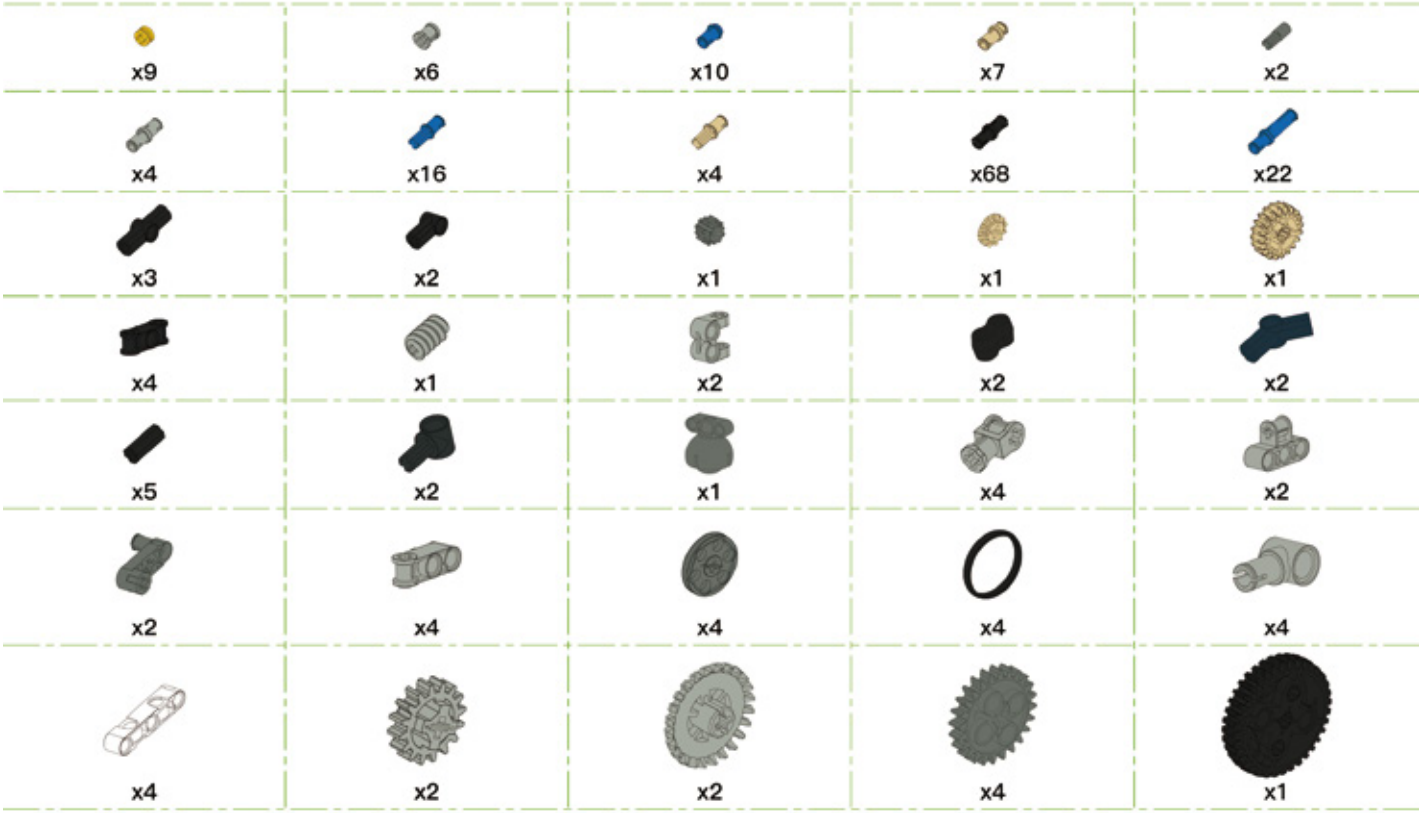
7. Brainstorming

The dump truck uses two DC motors and an IR reflective sensor module. Try to use the modules learned before to add some functions to the dump truck. For example, when the dump truck is moving back, the buzzer will sound an alarm. When the dump truck is unloading, the LED flashes; after the dump truck is unloaded, the LED light goes out.

Parts List


x3
3
x6
3
x6
x5
5
x4
7
x5
9
x4
11
x3
13
x4
15
x5
x4
x4
x5
②
x4
③
x4
④
x6
⑤
x3
⑥
x3
⑦
x1
⑩
x2
x5
x2
x1
⑫
x2
x1

Parts List


x9
x6
x10
x7
x2
x4
x16
x4
x68
x22
x3
x2
x1
x1
x1
x4
x1
x2
x2
x2
x5
x2
x1
x4
x2
x2
x4
x4
x4
x4
x4
x2
x2
x4
x1