fischertechnik ROBOTICS

Begleitheft
Activity booklet
Manual d'accompagnement
Begeleidend boekje
Cuaderno adjunto
Folheto
Libretto di istruzioni
Сопроводительная инструкция
附带说明书
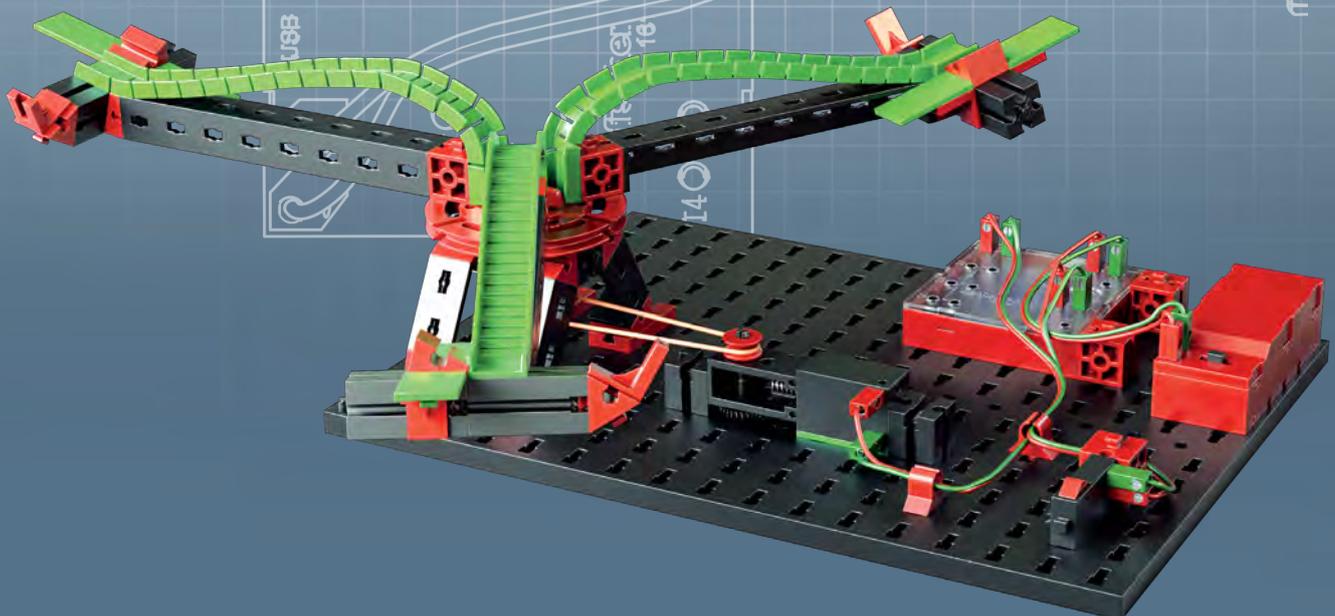
BT Smart Beginner Set 12 MODELS

Contents

ROBOTICS BT Smart Beginner Set

"Hi, first I'd like to introduce myself. I am your fischertechnik trainer and will accompany you through the entire book. I will often give you valuable tips and information."

"First, I would like to introduce you to the most important components contained in the ROBOTICS BT Smart Beginner Set, and give you some technical information on them."

Building blocks

The various building blocks are used to build the individual models. The picture shows a small selection of these models.
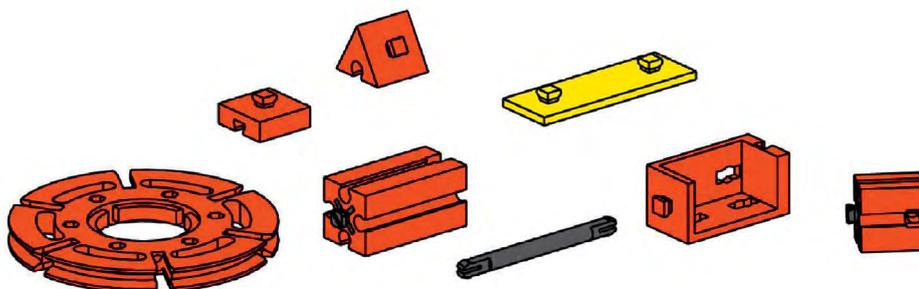
Electronic components

They look similar to the normal building blocks and can also be put together with the standard building blocks. They work with electrical power. Depending on the function, they are called actuators or sensors.
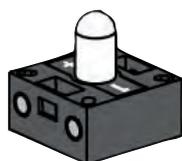
Actuators

They are called actuators because they are active, they do something. Components such as a motor or an indicator light perform certain work as soon as they are supplied with electrical power. The motor rotates and the indicator light is illuminated.

LED

A ⊲ C

**Circuit symbol**
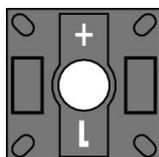
The abbreviation LED stands for "Light Emitting Diode" . When electric current flows through the diode (in the conducting direction), it radiates light at a wave length dependent on the semiconductor material.
There are two LED modules in the construction set. You can use them as a normal light as well as a light source in a light barrier.
Always pay attention to the polarity.

XS Motor

The direct current motor converts electrical energy into mechanical energy. This results in the rotary motion of the motor.
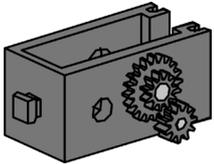
A motor also has a gearbox. You can reduce the speed of the motor with this gearbox.
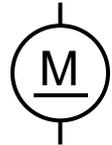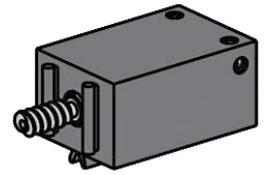
Circuit symbol

Sensors

Sensors, such as push-button switches or phototransistors, are components, with which actuators can be controlled. For example, a motor can be turned on or turned off with a push-button switch.

Push-button switches

Push-button switches are in the category of touch sensors. If you push the red button, a contact is mechanically moved in the casing and electric current flows between the connections 1 and 3. At the same time the circuit between contacts 1 and 2 is interrupted.
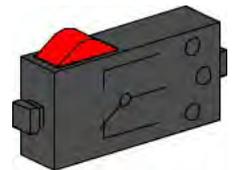
So, you can use the push-button switch in two different ways:

As a "closer":
Contacts 1 and 3 are connected.
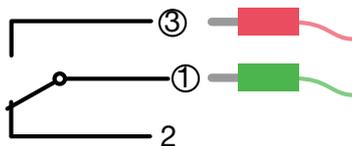
Push-button switch is pressed: electricity flows.
Push-button switch is not pressed: no electricity flows.

As a "break contact":
Contacts 1 and 2 are connected.
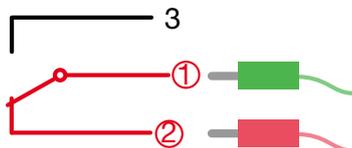
Push-button switch is pressed: no electricity flows.
Push-button switch is not pressed: electricity flows.

3
1
2
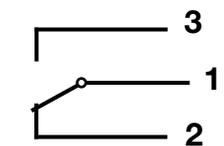
Circuit symbol

> ⚠ **In the construction set, ROBOTICS BT Smart Beginner Set, the push-button switch is always connected to contacts 1 and 3.**
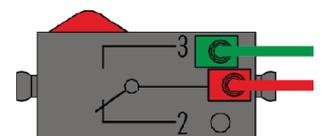
Phototransistor

A phototransistor is an electronic switch, which reacts to light. Of course, you have asked yourself how the entrance door in the department store opens automatically without you having to push a push-button switch or use a switch.

A light barrier is used to do this and this barrier consists of a light source (transmitter) and a sensor (receiver). In the construction set, an LED is used as the transmitter and a phototransistor as the receiver.

Circuit symbol

"So, now you have become familiar with the individual components. Perhaps you learned about these in school so they are nothing new for you."

Control   BT Smart Controller

■ The BT Smart Controller is the heart of this ROBOTICS construction set. Although you cannot see them, the Controller module has a number of electronic components. The interplay of these components with your computer and a control program allows you to control the models in the ROBOTICS BT Smart Beginner Set.

Here, some more technical information:
The Controller has four inputs (I1-I4) for connection of sensors (mini-switches, phototransistors), two outputs (M1-M2) for connection of actuators (motors, lights), an LED as operation indicator, a DC jack for connecting a power supply unit (9 VDC), two connecting sockets for a 9 V battery tray or rechargeable battery pack, and a mini-USB connection for data transmission from the PC to the Controller as well as a Bluetooth 4.0 interface for wireless transfer of data between the control and PC or tablet.
The frequency band is 2.402 GHz - 2.480 GHz, with a maximum radiated transmission power of 1.37 mW.

USB connection   Power pack connection

Sensors I1 - I4
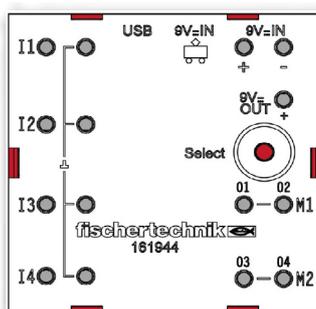
Battery connection

Bluetooth

Actuators M1 - M2

■ The BT Smart is supplied with power by a 9 V battery tray.
The table below shows the various system and program prerequisites:
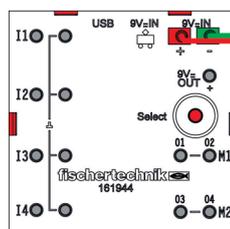
Power Supply 9 V Battery Tray

Windows 7/8/10	PC	USB		ROBO Pro Light
Windows 8/10	PC	Bluetooth 4.0 LE		ROBO Pro Light
Windows 7	PC	Bluetooth bluegiga, BLED 112-V1 (Stick)		ROBO Pro Light
Android 5.0 or higher iOS (as of May 2017)	Tablet or Smartphone	Bluetooth 4.0 LE		ROBO Pro Smart

Programming possibilities

■ ROBO Pro Light is the computer software you use to control your models in combination with the Smart Controller. You can download it from the "elearning Portal".
(www.fischertechnik-elearning.com)

ROBO Pro Light

Caution!
You need administrator rights on the PC to install USB drivers. The best thing to do for this step is to let an experienced PC user help you. Start the program for the next step.
If the controller is connected to the computer via USB, a Bluetooth connection is not possible.

ROBO Pro Light and USB

ROBO Pro Light and Bluetooth 4.0 LE
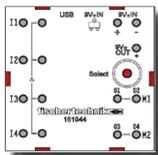
■ If you want to use Bluetooth, you need Bluetooth 4.0 LE for Windows 8 and 10.

Proceed as follows to use Bluetooth 4.0 LE with Windows 8 or Windows 10:

First install ROBO PRO Light. Then select "Show hidden symbols" in the task bar. A similar image appears. The important thing is that a Bluetooth symbol is depicted.

Add a Bluetooth Device
Allow a Device to Connect
Show Bluetooth Devices
Join a Personal Area Network
Open Settings
Remove Icon
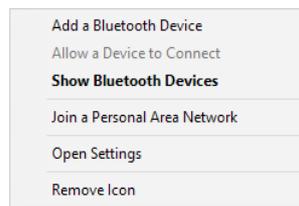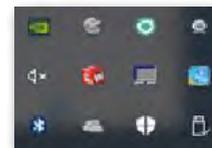
Click on the symbol with the left mouse key. A selection menu appears. Here, activate the first selection point, "Add a Bluetooth Device".

Now press the "red select button" until the controller appears in the selection window.

BT Smart Controller
Ready to pair
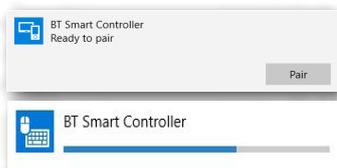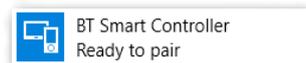
Click on the button with the mouse. The request "Couple" appears.

Click on this button with the mouse. Another window opens showing the coupling progress.

After successful coupling, the BT Smart Controller displays "Connected".

Important!
It is only possible to connect or couple **one** BT Smart Controller at a time to the PC. If, in addition to this connected BT Smart Controller, a second BT Smart Controller is simultaneously indicated as "coupled", it is necessary to remove it by *clicking with the mouse on "Remove device"*.

Now you can close the "coupling" window. If everything worked correctly, the ROBO Pro Light display then goes to:

No connection ➔ BT Smart Controller

Important!
Once the PC recognizes the controller, this coupling step is eliminated. ROBO Pro Light connects to it automatically.
If you plug in a USB cable while working with Bluetooth, the connection to the USB port is completed.

Windows 7 Bluetooth connection

Do you have Windows 7 installed on your PC? Unfortunately the 4.0 LE Bluetooth connection to the BT Smart Controller does not work, because Windows 7 does not use this state-of-the-art Bluetooth technology. But you can still make it work using a special Bluetooth stick with the designation:

bluegiga, BLED 112-V1

Proceed as follows to create a successful connection to the BT Smart Controller:

1. Plug the Bluetooth stick into a USB port on your PC.
2. Start the BT Smart Controller by connecting it to a power supply.
3. Start the ROBO Pro Light program on your PC.
4. Connect the BT Smart Controller to the PC by pressing the red select button on the controller for approx. 3 seconds until the blue LED starts flashing rapidly.
5. The BT Smart Controller and ROBO Pro Light are now connected. If everything works, the display changes from "**NO connection**" to "**BLED 112 / BT Smart Controller**".

To interrupt the connection, click on the "Unpair" icon on your tool bar in ROBO Pro Light. The connection is then interrupted.

To reconnect proceed as follows:
1. Close the ROBO Pro Light program on your PC.
2. Disconnect the power supply from your BT Smart Controller.
3. Reconnect the power supply.
4. Start ROBO Pro Light.
5. Connect the BT Smart Controller to the PC by pressing the red select button on the controller for approx. 3 seconds. This may take a while, but then the BT Smart Controller and your PC are reconnected.

Hardware Test
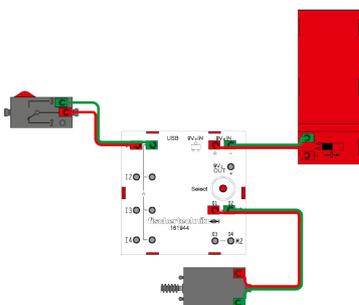
■ The next step is to test the hardware. For this purpose connect a motor to connection M1 on the controller and a push-button switch to connection I1. Open the ROBO Pro Light program. Click with the mouse on the motor icon for "Counterclockwise" or "Clockwise" rotation. You can change the speed with the slide control. Now also check the function of the push-button switch. When pressed, the arrow display should change.

ROBO Pro Smart

■ The ROBO Pro Smart App is available from the Google PlayStore for androids and at the Apple AppStore for iOS. Ensure you have Android 5.0 or higher.

ROBO Pro Smart and Bluetooth

■ After installing the App, you can open ROBO Pro Smart. For this purpose start the App on your tablet or smartphone.

The following working display appears. Not all of the commands are available yet. They will appear after coupling or connecting the controller to the tablet or smartphone.

Next connect the controller to the 9 V battery tray and switch it on. The green LED comes on, the blue LED flashes.
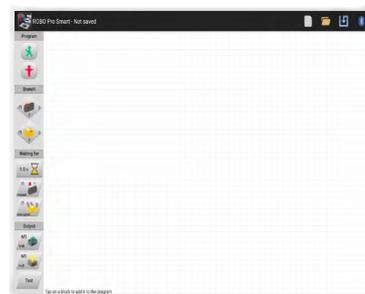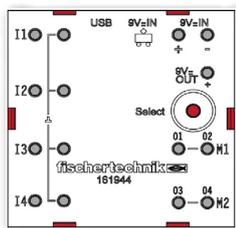
Activate the "Bluetooth" button 🔵 at the upper right edge of the display. A window appears with the text "Connect to BT Smart Controller". Read this text and then perform the work required. Press the red button on the controller for approx. 5 seconds.

The blue LED flashes rapidly. When the controller is found, it appears in the window.
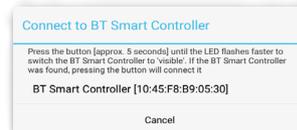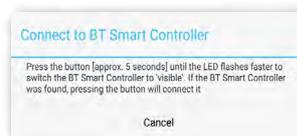
Tap on the display text that appears. The tablet or smartphone is then coupled to the controller. Successful coupling can be recognized by the fact that all commands now appear on the working display. Now the blue LED also illuminates continuously.
The following working display appears. Not all of the commands are available yet. They will appear after coupling or connecting the controller to the tablet or smartphone.

The next step is to test the hardware. For this purpose connect a motor to connection M1 on the controller and a push-button switch to connection I1.

You can switch on the motor using the arrows (left/right) on the trackball and have it turn either clockwise or counterclockwise. You can also switch it on with the speed bar. Press the trackball in the middle to shut off.
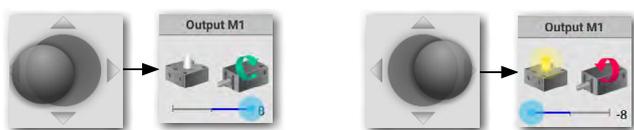
At the conclusion, press the push-button switch. The depiction of I1 in the "Inputs" window changes from "0" to "1". The red direction arrow also changes.

You have now completed everything required for the following tasks, programming with ROBO Pro Smart on your smartphone or tablet. Detailed instructions for using ROBO Pro Smart are given beginning on Page 30.
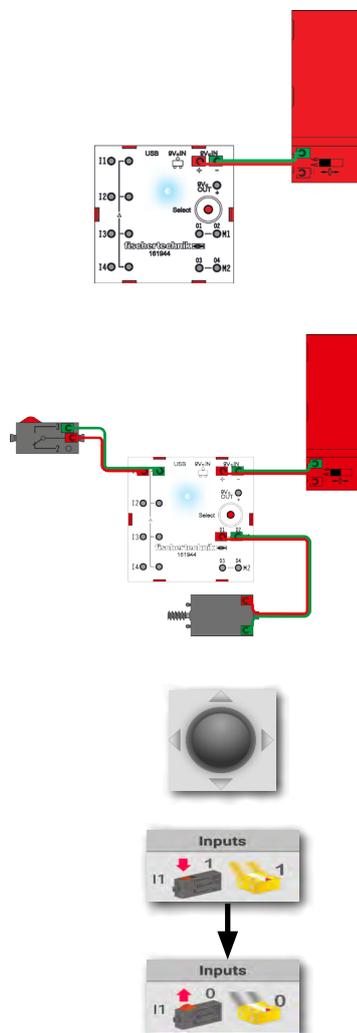
Programming with ROBO Pro Light
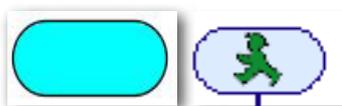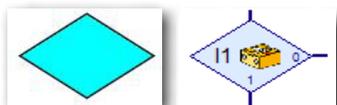
Program screen

Tool bar

Test window

Working screen

Program elements

International logic symbols

Starting / end point

Testing procedure

Action
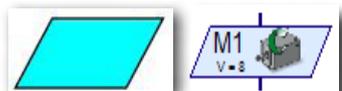
Input/Output
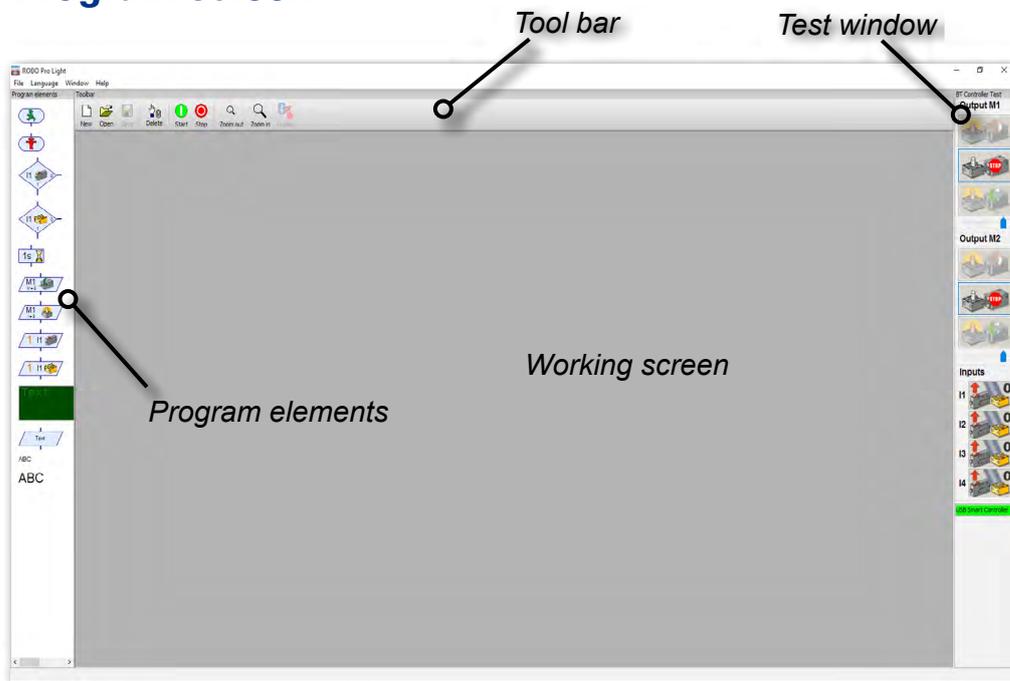
■ On the left side, you can find all **program elements** you need to create a control program.

The top line is called the **tool bar** and you have certainly seen this in other programs. Various menus to Save, Open or Start a program, for example, are displayed here.

The big window is the **working screen**. Here, you can create the control program.

The inputs and outputs for the BT Smart Controller are shown on the right in the **test window**. Here, you can turn the actuators on and off with the mouse, for example, to test whether they are connected correctly. This shows, for example, if a push-button switch is pressed or is not pressed. In addition, the green bar shows you if the connection between the PC and the BT Smart Controller is working properly.

"So, this was some theory at the beginning. Now, you would certainly like to build your first model and control it with the computer as well."

Merry-go-round – Entry Level Programing

■ You can find various models of merry-go-rounds at public festivals and amusement parks. The first motor driven merry-go-round was put into operation on January 1, 1863 in Bolton in England.

- Using the assembly instructions, build the model.
- Connect the electric cables according to the circuit diagram.
- Connect the BT Smart Controller to the PC using the USB interface (green LED on BT Smart Controller comes on).
- Start the software, ROBO Pro Light.
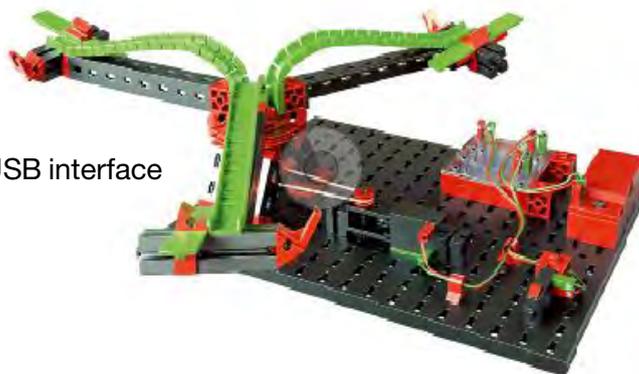
"Next, we want to create a control program together."

Task 1:

The merry-go-round is to be turned on and off with the mouse using the test window for the software, ROBO Pro Light. Which direction of rotation of the motor (counterclockwise or clockwise) allows the model to rotate correctly?

Press the push-button switch on the model. Now, on the screen, you should see how I1 changes from 0 to 1 when the red button is pushed.

Note!

If the value for the push-button switch does not change from 0 to 1 but from 1 to 0 when it is pressed then you have not connected the plugs to the push-button switch correctly (also see the description push-button switch). One plug should be connected to connection 1 and the other plug to connection 3.

What is a control program?

■ A control program tells the merry-go-round what it is to do. The software, ROBO Pro Light, has such a program consisting of various program elements, which are put together with arrows to form a sequence.
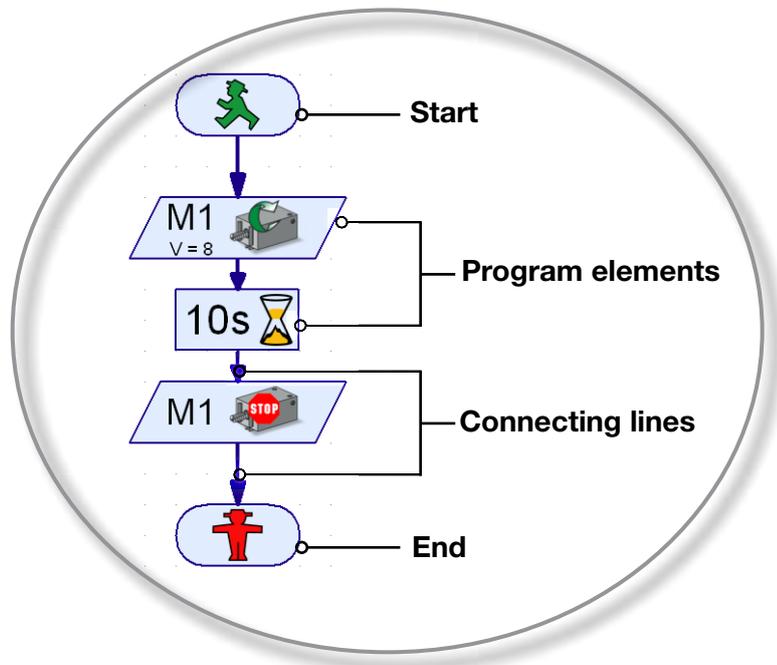
When the program is started, the routines are run one after the other. A control program in ROBO Pro Light begins with a little green traffic light figure (Start element) and ends with a little red traffic light figure.

Task 2:

Can you imagine what the sequence shown causes your merry-go-round to do?

Solution: The merry-go-round motor is started, runs 10 seconds and then it is turned off.

Now it is your turn and you can create your first control program.

Task 3:

The merry-go-round is to be started with the push-button switch (I1). It is to rotate for 10 seconds and then stop.

Proceed as follows:

- The ROBO Pro Light software is started, the BT Smart Controller is connected to the PC and supplied with electricity from the USB interface (green LED on Controller lights up).
- With the button, **File-New**, you begin a new control program.

File **–** New
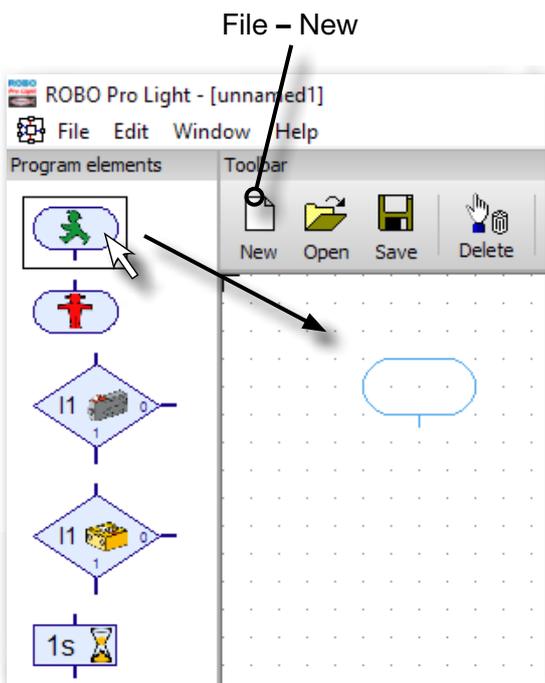
• You put the required program elements on the working screen with the mouse. You start with the green little traffic light figure. Click on the element with the left mouse button and just drag it onto the working screen. By releasing or again clicking the left mouse button, you place the element at the desired position somewhere on the working screen.

- As is described in the task, the merry-go-round meaning the motor M1 is to be started when the push-button switch I1 is pressed. In order to query the switch, you drag the element, **Query switch,** onto the working screen directly below the Start element. Both elements are automatically connected with each other.

- Move the mouse pointer over the element, which has just been inserted. As soon as the cursor turns into a hand, you can drag the element when the **left mouse** button is pressed. Press the **right mouse button**, to open the following dialog box:
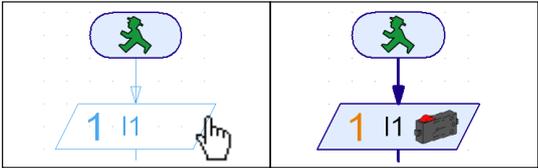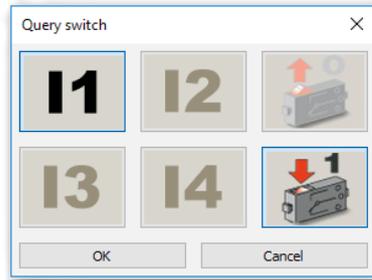
- In this window, you can set which push-button switch (I1-I3) you want to query and if the switch is pressed (1) or not pressed (0). I1 and "switch pressed (1)" are already preset so that you can confirm with **OK**.

- Now, as the next step, you are to insert the motor element into the sequence. As before, after the insertion, you open the dialogue box with the right mouse button.
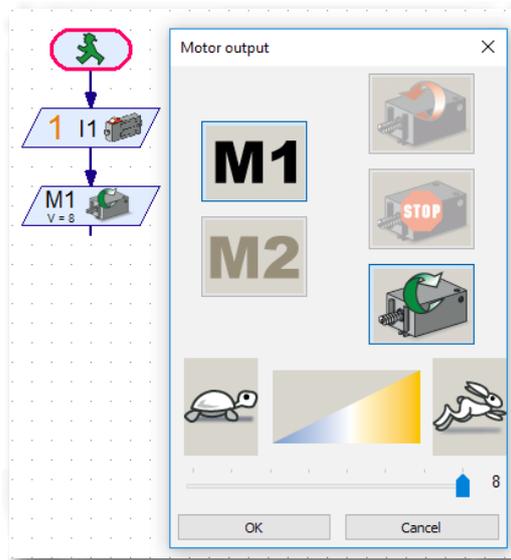
Here, you set the direction of rotation "clockwise" (green arrow). The connection M1 is already preset. Leave the slider control for the speed set on the far right. Then, the motor runs at full speed. Now, you can close the window with OK.

- Now, insert the element, Time delay.
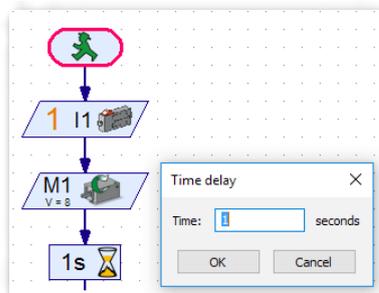
In the dialogue box, set the Time delay to 10 seconds.

• After this Time delay, the motor is to be turned off. Insert another motor element and in the dialogue box select M1 and Motor stop. Finally, you need the end symbol (little red traffic light figure). Your complete sequence then looks like this:
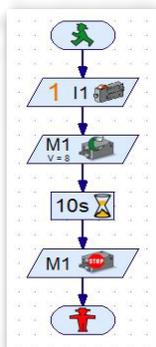
• Before you try out the program, you should save it so that it doesn't get lost. To do this, go to the Save button.
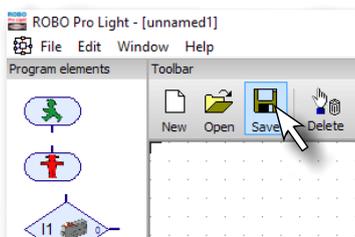
A standard Windows window appears. Here, you can select the folder, in which the program is to be saved. In addition, you can give a name to the file, for example, "Merry-go-round". The ROBO Pro file automatically receives the extension .rpl. Press the button, **Save**.

Selected folder

Enter the file name
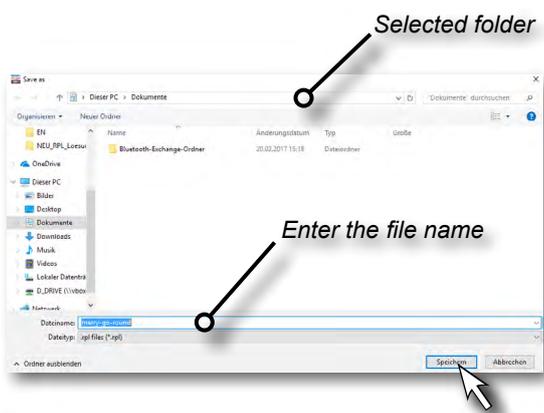
Depending on the Windows version, the window may appear somewhat different than the window shown here.

You have now saved the program and switched off your computer.

To continue working with the program a few days later, proceed in the same manner as when saving, except now you need to use the command **Open**. Select the folder where you saved the program and select the file name there. Then actuate the **Open** button.

*"OK, you
are already a big step farther.
Your program is finished and now
you can test it."*

Starting and stopping the program

To start the program, click with the mouse on the "Start" button.
As soon as you press the push-button switch, the merry-go-round turns
for 10 seconds and then stops. The program sequence has arrived at
the end symbol.

Beside the button for starting the program, you will find the button for
stopping. Regardless of where the program is at the moment, when you
press the Stop command, the program is stopped and ended.

Program loop

*"To avoid
restarting the program after every
program run, you can add a 'program loop'
to the program."*

Task 4:

Change the program so that after the motor stops, it does not jump
to the end symbol (little red traffic light figure) but returns to Query
switch. The end symbol is no longer needed and can be deleted.

Delete program elements and lines
- Click with the left mouse button on the button "Delete"   and then on
  the element or the line that you want to delete.
- Another possibility: Move the mouse pointer to the program element or the
  line that you want to delete and then click with the left mouse button. The
  element is marked red. Press the "Delete" key on your keyboard. When this
  is done, the marked element is deleted.

Delete the little red traffic light figure and the line between Motor stop and the
little traffic light figure.

Then, draw a connecting line from the end of the element, **Motor stop,** upwards
to the connecting line between the start symbol and Query switch.

Draw connecting lines by hand.
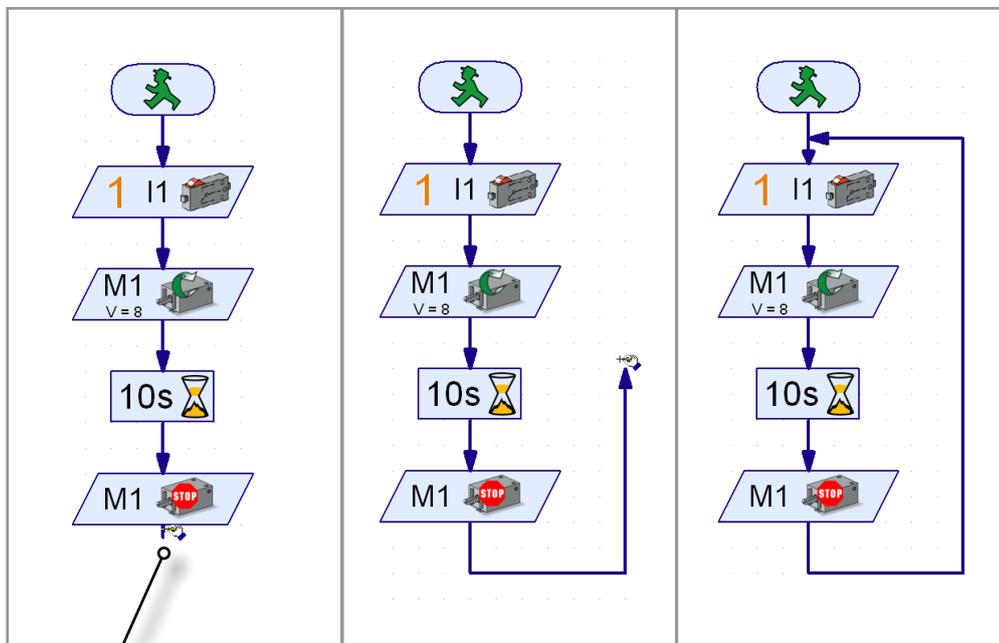
End, Start of line

- Move the mouse pointer to the end of the element, Motor stop. The mouse pointer turns into a hand with a pencil.
- Press the left mouse button and then release it. This is the way the line begins. Drag it with the mouse in the desired direction (first downwards).
- If you want to change the direction, then click once with the left mouse button. The line is then bent and you can pull it in another direction (first to the right and then upwards).
- When you get to the connecting line between Start and Query switch then click once again with the left mouse button. This then ends the line. The program loop is finished.

Note!
If you have drawn a line incorrectly by accident and you want to end it in the middle of the action then you can do this by double clicking with the left mouse button and then delete the line.

Save the program, for example, under the name Merry-go-round-2 and then try it out. Does it work like you wanted?

Note!
Since the little red traffic light figure is missing, the program must be ended with the Stop button.

Task 5:

Just going in one direction is rather boring. Change the program so that it waits a second after the motor stops and then the merry-go-round turns in the other direction for 10 seconds.

Do you have an idea which program elements you need in addition to solve this task? OK, I'll help you again.

When you expand the sequence as shown and then draw a program loop again to the start of the program, the entire thing is taken care of.

Save this program under any name as well, for example, Merry-go-round-3, so that you can use it again later.

So much for the merry-go-round. The construction set contains additional exciting models and programing tasks.

Have fun!

Pedestrian Light

■ You certainly have seen various models of traffic lights. You encounter pedestrian lights or entire intersection systems almost daily so that the principle is not anything new for you. Stated simply, lights are turned on and off in a certain sequence.

Build the model using the assembly instructions and connect the cables according to the circuit diagram.

Task 1:

Program a pedestrian light, which is switched with a push-button switch. At first, the light is red. When the push-button switch is pressed, the red phase is to continue for five seconds. This is to be replaced by a green phase, which lasts for 10 seconds. After this, the light returns to red.

Finished program: Pedestrian light-1.rpl (ROBO Pro Light)
                   Pedestrian-light-1.xml (ROBO Pro Smart)
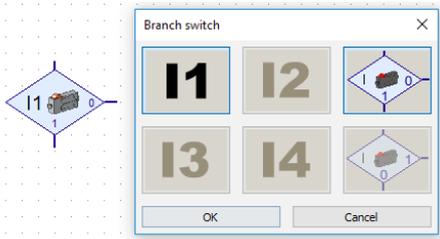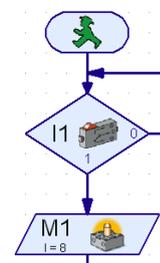
To query the push-button switch, use the command "Branch switch". Here, you have three connections. The program is set as follows: If the push-button switch is not pressed, go to output 0. If the push-button is pressed, go to output 1.
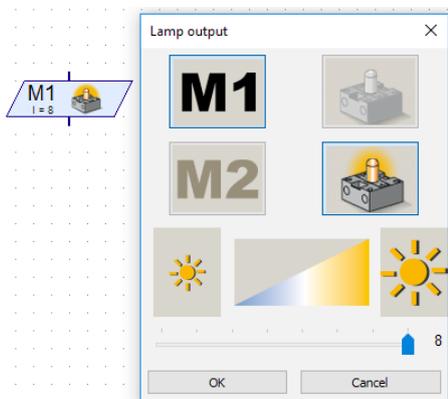
For the command "Lamp output," you also have the possibility of making various settings. You can set the brightness, the output (M1 or M2), and decide if the light is to be turned on or off.

Task 2:

As in task 1, program a pedestrian light, which is operated with a push-button switch. After the green phase is ended, the green light is to blink to show that the pedestrian light will change to the red phase in a short time. The green light is to blink three times.

*Finished program: Pedestrian light-2.rpl (ROBO Pro Light)*
Pedestrian-light-2.xml (ROBO Pro Smart)

Note:

You can find the solution to this task as a finished ROBO Pro Light program at *C:\ProgrammROBOPro-Light\Sample Programs\BT-Smart-Beginner-Set\ Pedestrian-Light-2.rpl*. You can also find sample programs in this directory for all other tasks in this activity booklet.

Lighthouse with blinking light

■ Lighthouses stand at important or dangerous points where they serve ships as a navigation mark, which is visible at long distances including at night. With their light signals (beacon), lighthouses show ships the way and thus allow navigation and the bypassing of dangerous positions in the waters.

Build the model using the assembly instructions and connect the cables according to the circuit diagram.

In the nautical charts, the characteristics of a beacon are described by uniform abbreviations, for example:

	The phases of light and dark are of equal length.
Flash	The light phases are shorter than the dark phases. A flash lasts for less than two seconds.
Blinking light	The light phases are shorter than the dark phases. An blinking light is at least two seconds long.
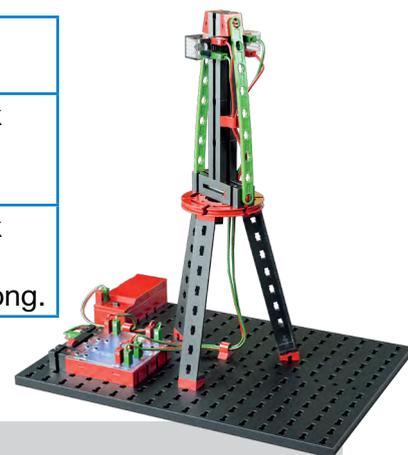
Task 1

Program a "beacon" according to the isophase principle. Set the light and dark phases to be of an equal length of two seconds.

Finished program: Lighthouse-1.rpl (ROBO Pro Light)
Lighthouse-1.xml (ROBO Pro Smart)

Task 2:

Program "lighthouse lighting" according to the flash principle.
For the flash lighting, set the light phase at 0.3 seconds and the
dark phase at 1.5 seconds.

Finished program: Lighthouse-2.rpl (ROBO Pro Light)
*   Lighthouse-2.xml (ROBO Pro Smart)*

Task 3:

Program "lighthouse lighting" according to the blink principle.
Both lights are to be illuminated for a different period of time
independent of each other. Switch on the system with the button.

Finished program: Lighthouse-3.rpl (ROBO Pro Light)
*   Lighthouse-3.xml (ROBO Pro Smart)*

Refrigerator Door

*"Gooood,
now let's move to a
topic, that you can find at home—a
refrigerator. Here, here, I always ask
myself if the light is really off, when I
close the door?"*

■ With the spread of electrical power and the refrigerator, its
forerunner, the ice box without electricity lost its attractiveness.
From a historical perspective, the word ice box is still used today
but when operated by electricity it is called a refrigerator.

Build the model using the assembly instructions and connect
the cables according to the circuit diagram.
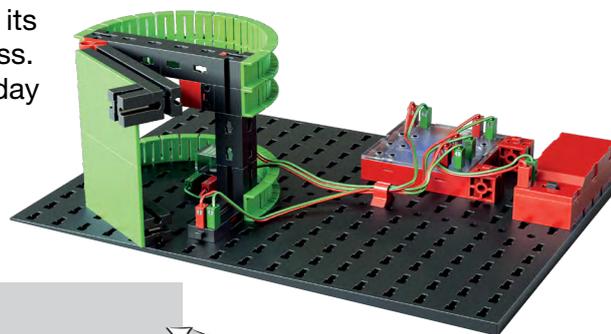
Task 1:

As soon as the refrigeration door is opened, the white light is to
light up. When the door is closed, the light goes out.

Finished program: Refrigerator-1.rpl (ROBO Pro Light)
*   Refrigerator-1.xml (ROBO Pro Smart)*

Task 2:

Supplement Task 1: If the refrigerator door stays open for more than three seconds, you want the red indicator light to start flashing in addition. It also goes out when the refrigerator door is closed.

Finished program: Refrigerator-2.rpl (ROBO Pro Light)
Refrigerator-2.xml (ROBO Pro Smart)

*"Wash day in the Nineteenth Century:
What a nuisance! Well we have it much easier today with modern machines."*

Washing Machine

■ The most widespread design is the drum washing machine, in which a washing drum rotates around an axis. The advantage of this machine type is the small size so that, for example, it can be installed in kitchen units.

Build the model using the assembly instructions and connect the cables according to the circuit diagram.
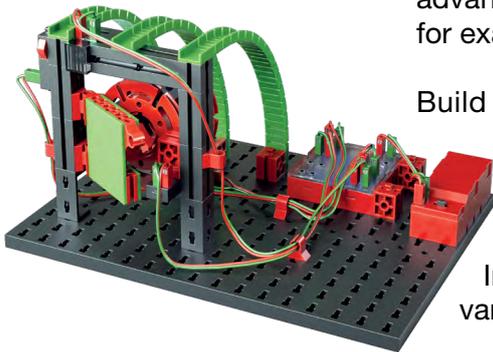
And now what all happens during a washing operation?
A washing cycle, a spin cycle and a drying cycle are performed.
In the following exercises, you will become familiar with and program various program parts.

Task 1:

After you push the Start button, the drum rotates at a low speed for 10 seconds (wash cycle). The display (indicator light on M2) shows the operation of the machine.

Finished program: Washing machine-1.rpl (ROBO Pro Light)
Washing-machine-1.xml (ROBO Pro Smart)

Task 2:

Change the program so that the washing machine only starts when the safety switch for the door is closed.

Finished program: Washing machine-2.rpl (ROBO Pro Light)
Washing-machine-2.xml (ROBO Pro Smart)

Task 3:

Place a spin cycle in the program. Here, the motor is to run at full speed for 15 seconds.

Finished program: Washing machine-3.rpl (ROBO Pro Light)
Washing-machine-3.xml (ROBO Pro Smart)

Task 4:

Expand the program with a drying cycle for the laundry. To do this, the drum rotates clockwise slowly at first (10 seconds) then takes a break of three seconds and then rotates counterclockwise for 10 seconds.

Finished program: Washing machine-4.rpl (ROBO Pro Light)
Washing-machine-4.xml (ROBO Pro Smart)

ROBO Pro Light offers the possibility to show certain working cycles such as washing or spinning as text in a display.
For this purpose, use the program element, "Text output".

You can insert this command at any position into your program if you want to send the user some information.

This information is then shown in the display field on the screen. As for other program elements, you can place the display field anywhere on the screen.

Important!
The text, which appears in the display, is overwritten by a new text command. If you don't want to display any text then leave the Text output empty.

Task 5:

During the program sequence, the user is always to be shown the current cycle in the text display. When all washing cycles are completed then the end is also to be shown in the display.
Change your program accordingly.

Finished Program: Washing machine-5.rpl (ROBO Pro Light)
Washing-machine-5.xml (ROBO Pro Smart)

Hand Dryer
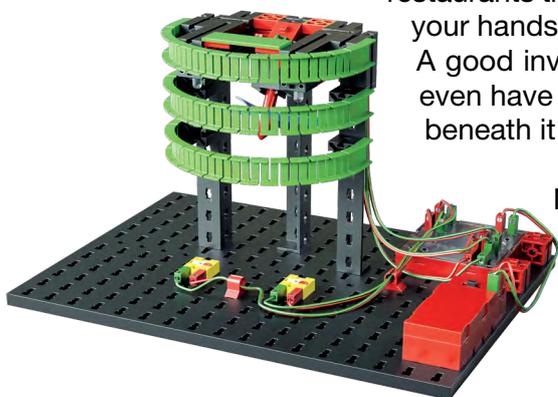
■ You certainly won't have anything like this in your bathroom at home. There you have a towel hanging on a hook. But in public toilets or the restrooms in restaurants there is usually an electric blower mounted on the wall for blowing your hands dry with hot air.

A good invention, particularly when the state-of-the-art appliance doesn't even have a button you have to push to turn it on. Simply hold your hands beneath it to turn it on.

Now you can build a hand dryer with a proximity type ON/OFF switch with the aid of the assembly instructions and wire it according to the circuit diagram.

Task:

When one of the two light barriers is interrupted, the fan should start running. As soon as the light barrier is no longer interrupted, the fan switches back off.

Finished program: *Hand dryer.rpl (ROBO Pro Light)*
                             Hand-dryer.xml (ROBO Pro Smart)

Barrier

■ Barriers are located in front of many parking lots or parking buildings. They open when a car drives up and close again after the car drives through. Have you every wondered how the barrier knows when a car is standing in front of it and it needs to open?

Build the model using the assembly instructions and connect the cables according to the circuit diagram.

Task:

At the beginning the barrier should be closed. Then when the light barrier is interrupted, the arm moves up. After 3 seconds it should close again.

Finished program: *Barrier.rpl (ROBO Pro Light)*
                             Barrier.xml (ROBO Pro Smart)

Machine

■ The next models, with which you will be working, come from industrial or manual artisan production of parts.

First build the model of the punch. This serves for producing large quantities of identical parts. Your manually operated punch is based on simple mechanical principles. You place a workpiece positioned between the light barrier. The punching stroke can be actuated by pressing both push-button switches simultaneously. On your machine the punching force is generated by a motor with gearbox. The most important parts of your punch are:
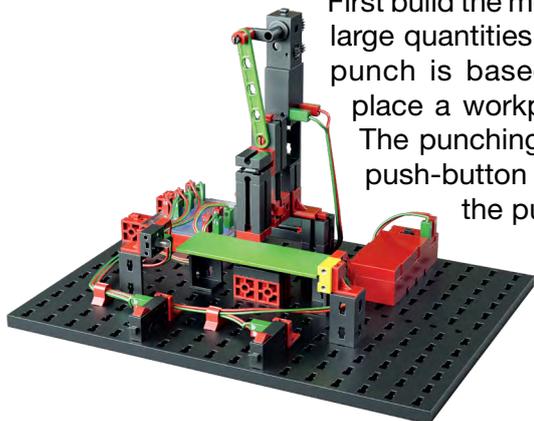
- Machine body
- Mechanism for transferring force
- Tools

Now we also have the issue of hand safety. To ensure that they are not in the punching area, it is necessary to press two push-button switches simultaneously. The distance between the push-button switches is so great, that you always have to used both hands. Many machines even have a third safety switch - usually a foot switch.

Task 1:

Place a workpiece between the light barrier. The punching operation should be triggered only when you press and hold both switches.

When one of the switches is released or the light barrier interrupted, the punch stops.

Finished program: Punch with safety switch-1.rpl (ROBO Pro Light)
*Punch-with-safety-switch.xml (ROBO Pro Smart)*

Conveyor Belt

■ During the first two tasks you probably noticed, that the punch does not return precisely to its end position. To accomplish this, it is necessary for you to install a second light barrier in your model. The purpose of this light barrier is to detect when the punch has reached its top dead center (TDC) point. Where do you think it would be best to install the light barrier?

In most cases the conveyor belt is a stationary conveyor. Particularly in mining or tunnel construction as well as industrial plants, this method is used to transport material such as packages, workpieces (unit loads) as well as excavated material from mining and tunnel construction (bulk material).
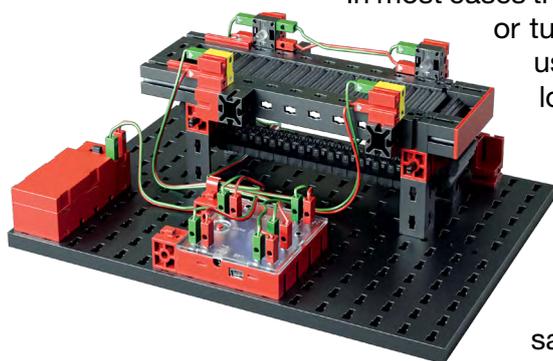
The conveyor belt consists primarily of a supporting construction. It supports the chain bearings (sprockets), the drive chain and the chain attachments as well as the drive station (drive sprocket, bearing, gearbox, motor) and various safety devices. Build the model using the assembly instructions and connect the cables according to the circuit diagram.

Task 1:

Program the system so that the belt starts when a workpiece interrupts the left light barrier. The belt switches off when the workpiece interrupts the second light barrier.

Finished program: Conveyor belt-1.rpl (ROBO Pro Light)
Converyor-belt-1.xml (ROBO Pro Smart)

You will find, that the workpiece is not transported to the end of the belt. What can you do?

Task 2:

Add a wait loop to the program, which requires that the belt stops only when it has reached the second light barrier.

Finished program: Conveyor belt-2.rpl (ROBO Pro Light)
Converyor-belt-2.xml (ROBO Pro Smart)

Conveyor Belt with Punch

■ For the next model, "Conveyor belt with punch" you can now program the conveyor belt so that when a workpiece is placed on the belt, it is conveyed to the end of the belt and, after a wait, is moved back to the initial position.

Task 3:

Expand your program as described above. After the workpiece has returned to it initial position, it will have to be removed (plan time).

Finished program: *Conveyor belt-3.rpl (ROBO Pro Light)*
Converyor-belt-3.xml (ROBO Pro Smart)

The next model is a combination of the punch and conveyor belt. Look in the Internet whether you can find any information on such a machine. Build the model using the assembly instructions and connect the cables according to the circuit diagram.
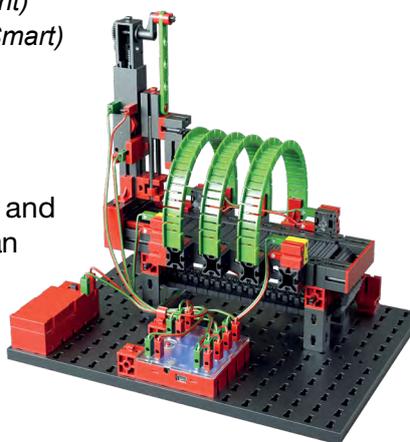
Task 1:

Place a workpiece between the front light barrier. The belt transports the workpiece to a position beneath the punch. The punch then performs its punching motion. After processing the belt returns the workpiece to its initial position.

Finished program: *Conveyor belt with punch-1.rpl (ROBO Pro Light)*
Conveyor-belt-punch-1.xml (ROBO Pro Smart)

Task 2:

Supplement your program so that the workpiece is punched numerous times before the belt returns.

Finished program: *Conveyor belt with punch-2.rpl (ROBO Pro Light)*
Conveyor-belt-punch-2.xml (ROBO Pro Smart)

Tracked Vehicle

■ Tracked or crawler vehicles are motor vehicles with tracks instead of wheels. They are used, for example, on bulldozers, backhoes and snowmobiles as well as on large bucket-wheel excavators for strip mining.

A primary advantage of tracked vehicles is their ability to maneuver in difficult terrain and their tracking accuracy. Moreover the large contact surface of the tracks prevents the vehicle from sinking in on soft surfaces.

They are steered by allowing the tracks to run at different speeds on each side. For example, to turn to the left, it is necessary for the track on the right side to move faster than the track on the left. They can even turn in place by stopping one track completely.

Direction of motion	Direction of rotation motor 1	Direction of rotation motor 2
Forwards	Counterclockwise	Counterclockwise
Backwards	Clockwise	Clockwise
Left	Counterclockwise	Clockwise
Right	Clockwise	Counterclockwise
Stop	Stop	Stop

Build the model using the assembly instructions and connect the cables according to the circuit diagram.

Task 1:

This task consists of programming a simple trip forward and back. The motion time in each direction is 3 seconds.

Finished program: *Mobile robot-1.rpl (ROBO Pro Light)*
Mobile-robot-1.xml (ROBO Pro Smart)

Task 2:

Change your program so that the vehicle moves forwards for 3 seconds and then back another 3 seconds.

Finished program: *Mobile robot-2.rpl (ROBO Pro Light)*
Mobile-robot-2.xml (ROBO Pro Smart)

For the next task image an industrial hall where autonomous vehicles transport material from one point to another. During this trip they have to overcome various obstacles.

Task 3:

Write a program with a number of direction changes (90 degrees).

Use different motion times. First start with a rectangle.

Finished program: Mobile robot-3.rpl (ROBO Pro Light)
*Mobile-robot-3.xml (ROBO Pro Smart)*

■ Now that you have already tested how a tracked vehicle moves forwards and backwards, as well as changing direction, this is a new challenge for you. Modify your vehicle so that it can recognize and automatically drive around obstacles with the aid of two push-button switches on the front.

Build the model using the assembly instructions and connect the cables according to the circuit diagram.

# Tracked Vehicle with Hindrance Detector

Task 1:

Build an obstacle course with the aid of books or pieces of wood.
Write a program that makes your vehicle move straight ahead initially. If it hits an obstacle on the left (left push-button switch) it should move back and drive around it to the right. The same applies when it hits something on the right (right push-button switch). It should move back a short distance and move around the obstacle to the left.
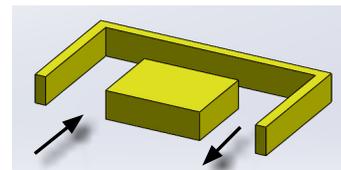
Finished Program: Hindrance detector.rpl (ROBO Pro Light)
Hindrance-detector.xml (ROBO Pro Smart)

Task 2:

Change your obstacle course with a labyrinth, which your vehicle is to find its way out of.
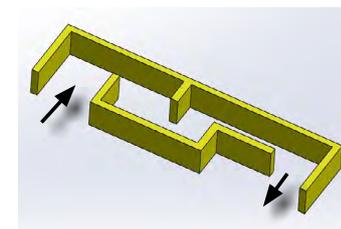
"You can find additional fischertechnik construction sets, with which you can expand your programing knowledge, at www.fischertechnik.de"

Programming with ROBO Pro Smart

"Beginning with this page we want to provide you with a few details on programming with your smartphone or tablet."

■ After downloading the ROBO Pro Smart App is usually on the main page with the various apps on our smartphone or tablet. Start the App and thus the program.

First couple the smartphone or tablet with the controllers as described on Page 6 and 7. The program display appears:

## International logic symbols
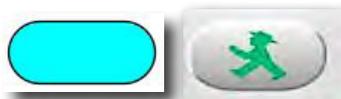
Starting / End point
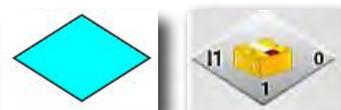
Testing procedure

Action

Input/Output
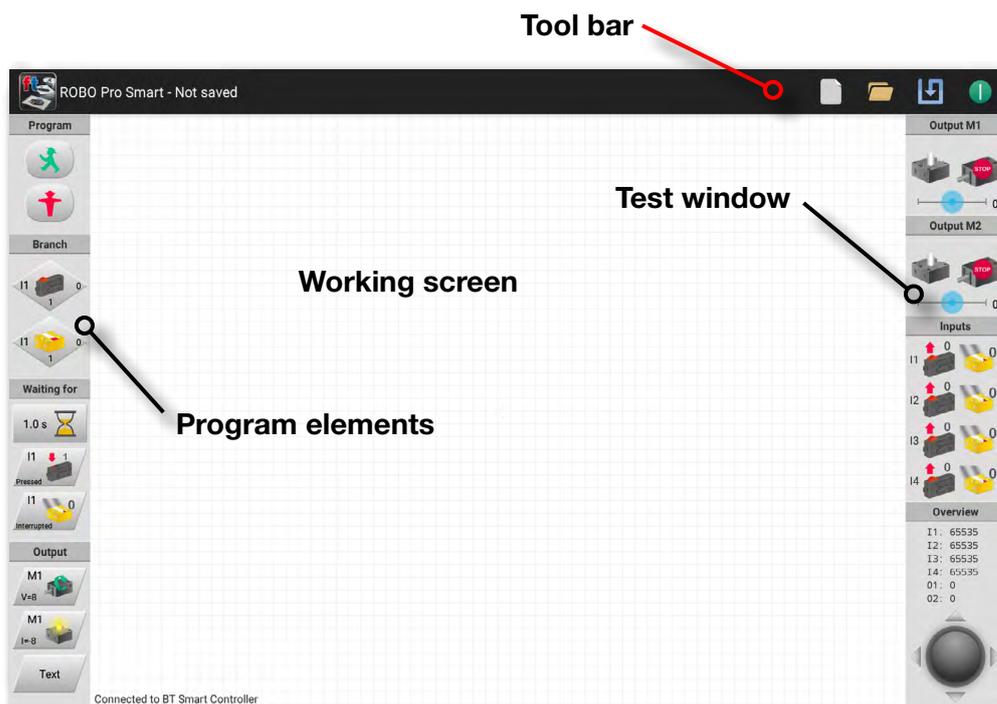
Tool bar

Test window

Working screen

Program elements

On the left side, you can find all program elements, which you need for the creation of a control program. The top line is called the toolbar and you have certainly seen this in other programs. It contains, for example: menus for saving, opening or starting a program. The big window is the working screen. Here, you create the control program. The inputs and outputs for the BT Smart Controller are shown on the right in the test window. They also serve to test the controller. You can zoom in or move the image by pulling and pushing with one or two fingers.

Merry-go-round – Entry Level Programing

"So, this was some theory at the beginning. Now, you would certainly like to build your first model and control it with the computer as well."

■ You can find various models of merry-go-rounds at public festivals and amusement parks. The first motor driven merry-go-round was put into operation on January 1, 1863 in Bolton in England.

- Using the assembly instructions, build the model.
- Connect the electric cables according to the circuit diagram.
- Use the Bluetooth feature to connect the BT Smart Controller to your smartphone or tablet
- Start the ROBO Pro Smart software.
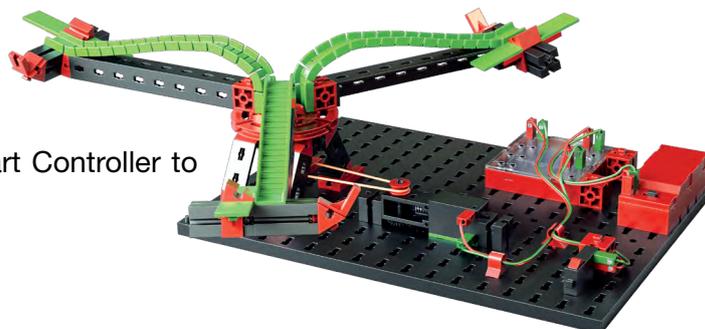
Task 1:

We want to program the merry-go-round so you can turn it on and off with your finger using the ROBO Pro Smart software. Which direction of rotation of the motor (counterclockwise or clockwise) allows the model to rotate correctly?

Press the push-button switch on the model. Now, on the screen, you should see how I1 changes from 0 to 1 when the red button is pushed.

Note!

If the value for the push-button switch changes from 1 to 0 instead of from 0 to 1 when it is pressed, you have not connected the plugs to the push-button switch correctly (also see description push-button switch). One plug should be connected to connection 1 and the other plug to connection 3.

"Next, we want to create a control program together."

What is a control program?

A control program tells the merry-go-round what to do. The ROBO Pro Smart App has such a program consisting of various program elements or routines put together with arrows or lines to form a sequence.
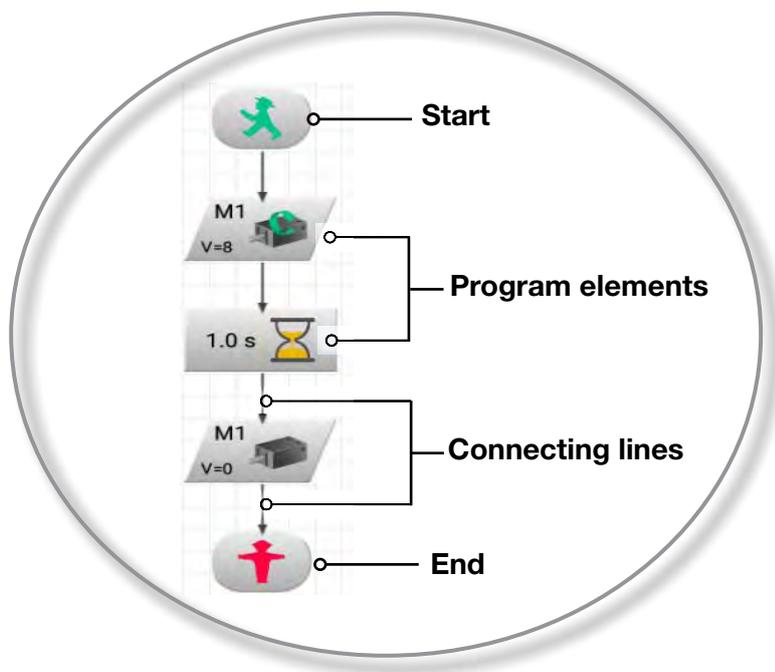
When the program is started, the routines are run one after the other. A control program in ROBO Pro Smart begins with a little green traffic light figure (Start element) and ends with a little red traffic light figure.

Task 2:

Can you imagine what the sequence shown causes your merry-go-round to do?

Solution: The merry-go-round motor is started, runs 10 seconds and then it is turned off.

Now it is your turn to create your first control program.

Task 3:

The merry-go-round is to be started with the push-button switch (I1). It is to rotate for 10 seconds and then stop.

Proceed as follows:

- Start the ROBO Pro Smart App, connect the BT Smart Controller to your tablet or smartphone using Bluetooth and supply it with power from the battery pack.

- Press the "New" button to start creating a new control program.

- Tap the required program element with your finger. It appears on the work screen. Start with the little green traffic light figure. You can reposition the program element with your finger.

- First place the program element for checking the push-button switch on the screen. This can be done the same way as with the little green traffic light figure.

- As you can see, both elements have a connection point labeled "Start" and "Previous".

- First select the "Start" point. The point changes color. Then select the "Previous" point. Both points are replaced by a line with arrow. The two points are now connected in the program.

- Next add the program element for the motor M1, followed by a time element, then another motor M1 and finally the "little red traffic light figure". Connect each of these using the appropriate connection points.

- Now you only need to make two more changes. First change the motor running time from 1 second to 10 seconds. The motor should also switch off after expiration of this time. For this purpose actuate the program element with your finger or a stylus until a display appears for entering the changes.
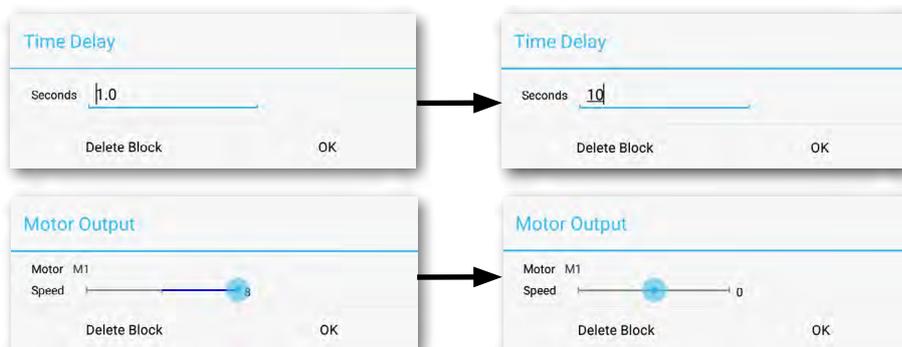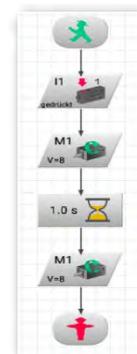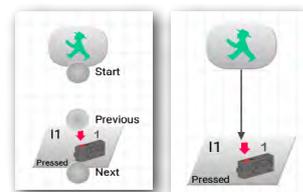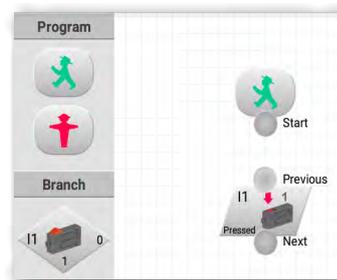
Before trying out the program, you should save it so that it doesn't get lost. To do this, go to the Save button.

An entry window appears. Enter a name for the program here, e.g. "Merry-go-round". The ROBO Pro Smart file is automatically assigned the extension.xml. Confirm this entry with OK.

Save Program

Please enter program name

| Cancel | OK |

Save Program

Please enter program name

merry-go-round

| Cancel | OK |
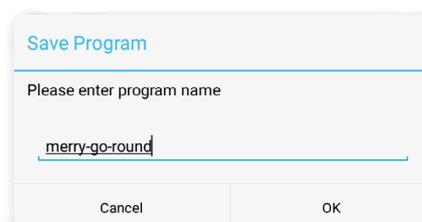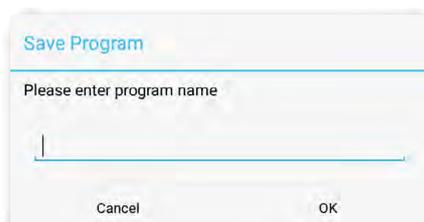
You have now saved the program and switched off your tablet or smartphone.

To continue working with the program a few days later, proceed in the same manner as when saving, except now you need to use the command **Open** . A window then appears listing all files - including Merry-go-round. Tap on the button to open the file and display it on the tool bar.

Load Program

merry-go-round

| Cancel | Examples |
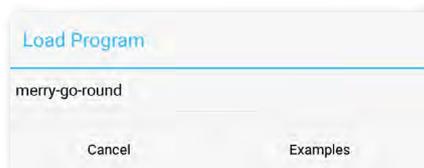
ROBO Pro Smart - merry-go-round.xml

"OK, you are already a big step farther. Your program is finished and now you can test it."

Starting and stopping the program

To start the program, tap the "Start" button.

The start button then changes to a red "Stop" button. Regardless of where the program is at the moment, when you press the Stop command, the program is stopped and ended.

As soon as you press the push-button switch, the merry-go-round turns for 10 seconds and then stops. The program has reached the "End" icon and the "Stop" icon changes back to green.

"To avoid restarting the program after every program run, you can add a 'program loop' to the program."

Program loop

Task 4:

Change the program so that after the motor stops, it does not jump to the end symbol (little red traffic light figure) but returns to Query switch. The end symbol is no longer needed and can be deleted.

To delete program elements and lines

- tap with your finger on the program element to be deleted until the block to be deleted appears in the entry window. Click on the "Delete Block" button to delete. The connection is also deleted.

Stop

This block has no settings

Delete Block   OK

M1
V=0

Stop

- Now you need an electrical connection from the end of the **Motor stop** element upwards to the connecting line between the Start icon and Query switch. First tap on the "Next" point on the motor element. This changes to purple. Then tap with your finger just above Query switch. The line, also called a program loop, is drawn.
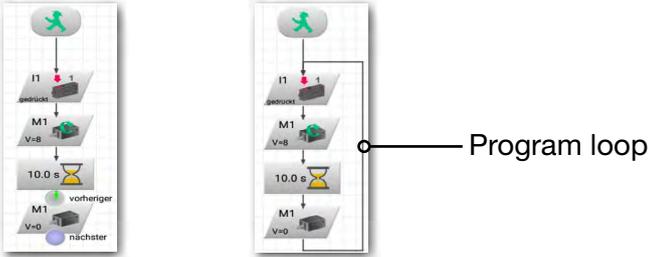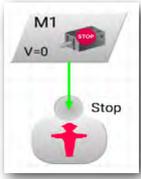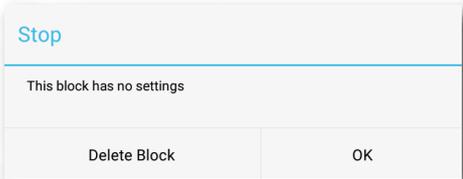
Program loop

Save the program, for example, under the name "Merry-go-round-2" and then try it out. Does it work like you wanted?

Note!
Since the little red traffic light figure is missing, it is necessary to end the program with the Stop button.

Task 5:

Just going in one direction is rather boring. Change the program so that it waits a second after the motor stops and then the merry-go-round turns in the other direction for 10 seconds.

Do you have an idea which program elements you need in addition to solve this task? OK, I'll help you again.

When you expand the sequence as shown and then draw a program loop again to the start of the program, the entire thing is taken care of.

Save this program under any name as well, for example, "Merry-go-round-3", so that you can use it again later.

So much for the merry-go-round. The construction set contains additional exciting models and programing tasks.

Have fun!

And one more tip: When you install the App, all your solutions to the examples are saved on your tablet or smartphone.

If something doesn't work right ...

... you will hopefully find a solution for your problem in this table.

Problem	Possible Cause	Fault Clearance
1. The ROBO Pro Light Software cannot establish a connection to the BT Smart Controller.	USB cable is not connected.	Plug in USB cable.
	USB driver is not installed.	Install USB driver—see installation instructions contained in the construction set.
2. When the USB is disconnected, the ROBOPro Light connection display remains red. No connection with Bluetooth	BT Smart Controller not coupled to PC with Bluetooth	Complete coupling procedure (see Chapter ROBOPro Light and Bluetooth 4.0 LE)
	The connection between ROBOPro Light and the BT Smart Controller does not change over to Bluetooth automatically.	Restart ROBO Pro Light, if necessary, momentarily interrupt the power supply to the BT Smart Controller
3. The push-button switch does not work.	Electrical connectors plugged into wrong connections on push-button switch or on BT Smart Controller.	Use connections 1 and 3 on the push-button switch. Connect the plugs to the two jack sockets for I1, I2 I3 or I4 on the Controller.
	With self-written control programs: Wrong output, M1or M2, selected in program element dialog field.	Check control program and set correct input.
4. Phototransistor does not work.	Electrical plugs plugged in incorrectly.	Connect the red plug to the side with the red dot, green plug to the side without marking. Connect red plug to I1, I2 or I3 or I4, green plug to associated connection.
	LED for light barrier does not illuminate.	Connect LED to M1 or M2 and switch on; observe polarity.
	The light beam from the LED passes by the phototransistor diagonally.	Move the LED so that the light beam hits the phototransistor.
	With self-written control programs: Wrong output, M1or M2, selected in program element dialog field.	Check control program and set correct input.

Problem	Possible Cause	Remedy
5. Motor does not rotate or LED does not illuminate.	Motor or LED not connected to BT Smart Controller.	Connect motor or LED to BT Smart Controller as shown in circuit diagram for specific model.
	Motor or LED connected to incorrect motor output on BT Smart Controller.	Use circuit diagram to check which output, M1 or M2, is to be used for the motor or the LED and connect to this output.
	With self-written control programs: Wrong output, M1or M2, selected in program element dialog field.	Check control program and set correct output.
	The green LED on the BT Smart Controller flashes very rapidly (approximately four times per second): Short circuit at one of the outputs. Positive and negative poles are directly connected.	Check cables and eliminate the short circuit.
6. Motor rotates in wrong direction.	For electrical plugs, red and green mixed up.	Reverse red and green plugs on motor.
		Change the direction of rotation of the motor in the control program.
7. Sample programs cannot be found for the models.	You do not know the name of the folder containing programs.	Sample programs for all models in the construction set are available at *C:\Programme\ROBOPro-Light\ Sample Programs\BT-Smart-Beginner-Set*
8. ROBO Pro Smart software cannot establish a connection to the BT Smart Controller.	No Bluetooth connection.	Observe maximum distance between devices. Maximum range up to approx. 10 m.
9. Problem not described here.	Not found.	Contact fischertechnik directly, for example, at: **www.fischertechnik.de**