Chapter 9

Expanding Your Options with Kits and Creative Solutions

Solutions in this chapter:

- Acquiring More Parts
- Creating Custom Components
- Creative Solutions When More RCX Ports Are Needed

Introduction

If, by now, you are caught up in robotics, you may feel a bit constrained by the limitations of the MINDSTORMS kit. You want more. What do you perceive most limiting: the number and range of parts, or the fact your RCX has only three input and three output ports? Maybe you would like to use new kinds of sensors, or servo-motors. And why not try out some pneumatic devices?

If the MINDSTORMS was your first LEGO set, you will be pleased to see that there are many additional parts to boost and support your creativity. If MINDSTORMS is an addition to your large collection of LEGO TECHNIC sets, you already know what parts the line includes and probably already have them—but there is a also wealth of compatible non-LEGO custom parts and kits you may never have dreamed of: infrared and ultrasonic proximity detectors, compasses, sound frequency decoders, magnetic switches, and voice recognition units, just to mention a few. In this chapter, we will explore some options for expanding your designs and plans, surveying the most important additions, providing you with information about where and how you can get them, and describing also the most significant non-LEGO custom devices.

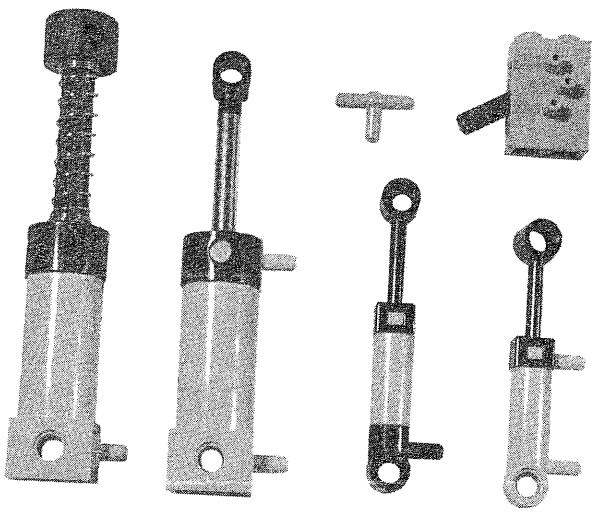
Extra parts are not the only way to expand your project ideas. Some mechanical tricks can also help you in getting the most from the limited number of output ports offered by the RCX. You will learn how a single motor can power two or more mechanisms, and how you can apply this trick to some of the mobile configurations we described in Chapter 8.

Acquiring More Parts

Describing all the components that make up the LEGO world would be a tremendously difficult task. The vast LEGO system includes tens of thousands of different parts, belonging to different themes, but all are easily integrated with each other. That's the beauty of LEGO: You can always find a new use for something that might have been built with a completely different purpose in mind. Whether it be towns, trains, or pirates, any or all of the LEGO themes might add something useful to your set of equipment. Of course, when it comes to building *robotics*, the natural choice is the LEGO TECHNIC line.

Created in 1977 to introduce older children to the world of mechanics and motors, the TECHNIC line developed into a complete system that includes many specialized parts. You are already familiar with the almost 140 varieties found in the MINDSTORMS kit, organized into some of the classes previously mentioned—beams, plates, axles, liftarms, gears, and so on.

Figure 9.9 Components of the Pneumatic System



Designing & Planning...

Choosing Colors

Most TECHNIC parts come in a large assortment of colors, which include the traditional LEGO colors (white, red, blue, yellow, green, black, and gray) and some more recent ones (tan, dark gray, light blue, light-green, lime, purple, orange, and brown). If you care about colors as much as we do, this is great news; a conscious use of colors can improve the appearance of robots. However, there's much more that colors can do for you: they can help in making the structure and the mechanisms of your robot more evident. In our favorite scheme, we use two colors for the body of the robot: one for plates and another for beams, liftarms, and all the other static parts. This makes the layered structure very easy to read. Then we use one or two additional colors for mobile parts to highlight their function in the robot. For example, the fact that you employ a beam as a connecting rod between two parts of a mechanism is more apparent if its color stands out against the prevalent colors of the robot.

In large and complex robots, you can use colors to identify its subsystems: one color for the mobile platform, another for the grabbing arm, a third for the rotating head, and so on for each relevant unit.

Continued

Colors help also in keeping the wiring neat when necessary. A dual RCX robot, for example, can use up to 12 input and output connections, and some of these wires are probably not so easy to trace inside the structure of the robot. Place pairs of small plates on the connectors at both ends of a wire, using a different color for each wire, and you'll have no problem understanding which port is connected to the motor and which is connected to the sensor.

Buying Additional Parts

Now that you've seen all these parts, you might wonder where you can get them. This is a very good question which, unfortunately, has no easy answer. There are general accessory sets, themed sets, expansion sets, and service packs, as well as general catalogues. Each may offer more or less than you need at one time, and price may also be a factor.

The MINDSTORMS line has many sets, but in our opinion some of them are priced a bit too high for their actual value. The 3801 Ultimate Accessory Set is a good choice, including a rotation sensor, a touch sensor, a light brick, a remote control, and other parts.

The 9732 Extreme Creatures Set contains few interesting parts for its price, but remember the Fiber Optic System unit, as explained in Chapter 4, can be used as a rotation sensor, too. The 9730 RoboSports Set is a bit more interesting, as it contains an extra motor. The most notable parts contained in the 9736 Exploration Mars Set are two gearboxes, six balloon tires, two very long cables (3m) and a bunch of beams, plates, gears, and connectors. In our opinion, these three sets are good purchases only if you find them at a reduced price.

The 9735 Robotics Discovery Set contains a unit called *Scout* that's a sort of younger brother of the RCX. Scout incorporates a light sensor, and features two output ports for motors and two input ports for sensors (passive types only: touch and temperature). It has a large display and offers some limited programmability from its console, without the need for a PC, thus offering an easy start to robotics. Despite this nice characteristic, we feel it's a bit too limited.

The two Star Wars MINDSTORMS sets, the 9748 Droid Developer Kit and the 9754 Dark Side Developer Kit contain an even more limited unit, MicroScout, that incorporates a motor and a light sensor, but has no ports. It has seven predefined programs, and can be interfaced to the Scout with an optical link to act as its third motor. Through the Scout you can also download a tiny program to the MicroScout. In our opinion, MicroScout is definitely too simple

to be used for robotics, so we again suggest you buy these sets for their parts, and only if you find them for sale at a discounted price. If you really want another programmable brick, we strongly recommend a second MINDSTORMS kit, which with its RCX, two motors, three sensors, and more than 700 additional parts, in our opinion remains your best option.

LEGO also released a video camera system called 9731Vision Command. The camera connects to your PC, and a dedicated LEGO software can send IR commands to your RCX unit, through the tower, according to what happens inside the observed area. Don't dream of recognizing shapes or performing other sophisticated artificial vision tasks, since Vision Command allows only very basic reactions to changes in some predefined areas of the screen. You will discover also that the cable that links the camera to the PC is a constraint to your robot mobility. Despite these limitations, however, Vision Command opens up a world of possibilities.

MINDSTORMS expansion sets are an option, and TECHNIC sets another. Sad to say, but the current TECHNIC line does not include many expansion sets with suitable parts for robotics. Old TECHNIC sets had more beams and plates then current ones do, which, as we explained, tend to rely more and more on studless liftarms, which are useful but somewhat complicated to use. If you are so lucky as to find some discontinued TECHNIC sets, you have a good chance of it better suiting your needs. Being bound to the current production, large sets are a better purchase than small ones, having a higher ratio between functional and decorative parts. We prefer not to suggest any specific model here, as each fan has his or her own preferences; also, every year LEGO releases new sets and discontinues others.

With all that said, it is perfectly understandable that you may simply wish to buy only the specific parts you need. LEGO offers a mail service, called Shop-At-Home, from whose catalog you can order both sets and *elements packs* or *service packs*. Recently LEGO started an online service called LEGO Direct, through which you can order from your computer, pay with your credit cards, and get the parts or sets shipped to your door. LEGO Direct has been greeted with great enthusiasm by LEGO fans who see it as the promising beginning of a new era, one where everybody can order only the specific parts they need from a complete catalog. Currently, LEGO Direct offers the current line of sets and a limited choice of service packs, but the range is increasing and we all hope that it ends in a thorough and practical worldwide service.

Another useful resource is the DACTA service. DACTA is the branch of LEGO devoted to educational products, whose catalog includes a wide range of sets and supplementary kits. Though packed with a different assortment, the DACTA boxes contain the same parts used in commercial LEGO products. In all

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