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IMPORTANT SAFETY INFORMATION

When using the ER1 Gripper, basic safety precautions should always be followed including:

READ ALL INSTRUCTIONS FOR BOTH THE ER1 ROBOT (INCLUDING SAFETY INFORMATION) AND THE GRIPPER ARM BEFORE USING

KEEP GRIPPER MOTOR AWAY FROM WATER

WARNING: IMPORTANT GRIPPER ARM SAFEGUARDS

- The ER1 Gripper is designed for use with the ER1 Robot and should not be used in any manner not expressly approved or recommended by Evolution Robotics.
- Do not under any circumstances use the ER1 Gripper to move, touch or handle dangerous or hazardous materials. Doing this could result in injury or death to the user or damage to property.
- Do not attempt to grip, carry, and/or release fragile, flammable or poisonous items, pets, children, or open containers of hot liquid. Extremely fragile items may be dented or damaged if gripped.
- To prevent fire or shock hazard, do not expose the ER1 Gripper to rain or moisture.
- To avoid electrical shock, do not operate in or near water.
- To avoid damage to property or injury to persons, always operate the ER1 Robot and Gripper under close supervision. THE ROBOT AND GRIPPER ARM SHOULD NEVER BE LEFT TO OPERATE UNATTENDED OR UNSUPERVISED.
- Do not operate the ER1 Robot and Gripper outdoors, near stairs or on top of furniture.
- Keep hair, loose clothing and all body parts away from the Gripper and away from all openings and moving parts.
- Releasing objects from the Gripper will cause them to fall. This is an intentional part of the design, but may cause damage or destruction of the object being released, and/or the area onto which the object falls. This includes the laptop mounted on the ER1 Robot, especially if the Gripper is installed so that the pincers are directly over the laptop's keyboard. BY USING THE ROBOT AND THE GRIPPER ARM WITH YOUR LAPTOP COMPUTER, YOU ARE ASSUMING ALL RISKS FOR ANY DAMAGE TO YOUR LAPTOP COMPUTER.
- Similarly, do not rely on the Gripper to maintain an indefinite, secure grip on an object. Although the Gripper is designed for secure transportation of objects, there is no guarantee that an object will not slip out of the Gripper.
• Do not attempt to carry items heavy enough to cause the ER1 Robot to tip over. How much weight the ER1 Robot can hold depends on the configuration of the robot, and where on the robot the Gripper is installed.

• Use common sense when employing the Gripper. It is possible for the Gripper to pull a heavy item, such as a bookcase, over onto itself, potentially damaging or destroying the robot, and/or surrounding items, and injuring humans/pets.

• Our product parts may contain sharp edges and should be handled with caution to avoid injury.

• The object being gripped should extend no lower from the Gripper than 1" above the floor. That is, the object should not drag on the floor. Doing so may damage the item being gripped or the robot.

• The Gripper is not a toy and is not recommended for children.

• Do not open any of the electrical components housed in sheet metal units or plastic, as this might result in fire or shock hazard.

• Store packing materials safely out of reach of children to prevent the risk of suffocation from plastic bags.

• Use only as described in the instruction manual.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. 47 C.F.R. section 15.21.

Additional Gripper Operational Tips

• Never hold the Gripper closed when it is trying to open. Doing so will damage it.

• The ER1 Gripper will not release objects that are larger than three inches in diameter at the point where they are being gripped.

• Items (such as clear CD cases) that are IR-transparent will not trigger the Gripper to close.

• A very close, very bright light may accidentally trigger the IR sensors, causing the Gripper to close without an object in it. Similarly, smoke or mist might also cause false-positive closings.

• When gripping large objects, the ER1 Gripper may emit a humming noise. This is normal.

• Do not slightly close the ER1 Gripper manually. If you do so, the ‘object in gripper’ sensor won't trigger when you later place an object in the Gripper. You can correct this problem by pressing the Gripper’s ‘Open’ button on the back of the Gripper.

• Do not open the Gripper manually. If you do so, it will not automatically open again until you've issued a Close command to the Gripper.

• If you select the Close Gripper button and then quickly deselect it, the Gripper may not return to the open position. In that case, wait until the action completes, click the Close Gripper button, wait until the action completes, then click the Open Gripper button.
Evolution Robotics is pleased to introduce you to the ER1 Robot Gripper Arm, which we’ve designed to enhance your ER1 Personal Robot experience. The ER1 is the first genuinely useful and affordable personal robot that is also extendable and programmable by you. The ER1 Gripper Arm is one of a suite of ER1 accessories.

The Gripper Arm allows your robot to grasp, transport and release soda cans, envelopes, children’s blocks, etc. You can grip and release objects under the ER1 Robot Control Center software (RCC) remote control, program your robot to use the Gripper as part of a complex series of behaviors or control the Gripper using a joystick. The Gripper Arm’s design provides easy operation and useful functionality in a single accessory.

This document is intended to get you started with your Gripper Arm. It provides step-by-step instructions, with plenty of pictures, for attaching the Gripper in two different
locations on the robot. It also provides instructions on loading the software and configuring your laptop to recognize the Gripper.

This document provides all of the information you need to use the Gripper and other new features of the 1.1.0 software. We’ll have a new version of the \textit{ER1 User Guide} soon. This will contain information on the ER1 Gripper Arm and new software features. This will be available for download on our website at \url{www.evolution.com}.

\section*{New Features}

A new 1.1.0 version ER1 Robot Control Center (RCC) software is shipped with your Gripper. It includes Gripper support and these other new features:

- USB joystick support for remote ER1 and Gripper operation
- Redesigned GUI with:
  - New If / Then activation
  - New X, Y move commands
  - New remote control indicator
  - Informational popup messages moved to Log
  - Ability to choose same color for \texttt{If} triggers and \texttt{Then} actions
  - Redesigned Navigation control, and \texttt{Mute} and \texttt{Recognize} buttons
  - Multiple object selection for \texttt{Sight} triggers
  - Restructured \texttt{Move} area for easier programming.
  - Redesigned \texttt{Time} area with a seconds setting added.
  - Reset button for X, Y coordinates

\section*{Gripper Specifications}

The following are the specifications for the ER1 Gripper Arm.

- Length - 22" 
- Weight - 1.5 lbs
- Squeeze force- 275 grams (Do not attempt to grasp fragile items.)
- Can grasp any object that is smaller than 3" x 4" at the point being gripped
- Can hold objects up to 2 lbs (.9072 kg)
- The object being gripped should extend no lower from the robot arm than 1" above the floor. That is, the object should not drag on the floor.
The Gripper employs an infrared (IR) LED and receiver to detect when an object is between the gripper’s two pincers. The default behavior of the powered-on Gripper Arm is to open in a ready state. Unless programmed otherwise, the pincers will be ready to close as soon as an object is detected via IR sensor.

You can use the ER1 RCC software to command the Gripper to open/close, program the Gripper to open/close as part of a behavior sequence, use the joystick to open and close the Gripper, or as part of your own Gripper programs.

**Important Note:** For safety purposes, the powered-on Gripper can always be opened by pressing the Open button on the Motor Enclosure.
Customer Support

Evolution Robotics Customer support is available by email at customerservice@evolution.com or by filling out the form at www.evolution.com/support. Customer Service representatives are available by calling toll free at 866-ROBO4ME (international customers can call 626-229-3198), Monday though Friday, 9 A.M. to 5 P.M. Pacific Time.

Additional Resources

You should already be familiar with the ER1 robot community (www.evolution.com). If not, log in and create an account for yourself, as described in the ER1 User Guide that came with your robot.

Find suggestions for amusing Gripper applications, comments from other users, and behaviors you can download that are optimized for use with the Gripper. Take a picture of your robot using the Gripper and post it in our ER1 community. We can’t wait to see what you’ll come up with!

Our web site will also give you information on other ER1 accessories. Presently, we’re on track to provide:

- A second battery pack, which you can swap out with the original battery, so that while one is charging, you can use the other to extend your robot’s run time.
• An XBeam Robot Expansion Pack, which lets you reconfigure your robot into a virtually unlimited number of shapes and models. It also lets you build accessories such as trailers and backpacks.

• An IR sensor pack, which improves your robot’s navigation capabilities by using the sensors to intelligently navigate around a space with "object presence" detection.

Check our web site frequently for availability, pricing, and other information. New accessories will be added as we develop them. Each of these accessories can be used alone or in conjunction with each other and with the ER1 Gripper Arm you just purchased, giving you the power to design a robot that exactly fits your needs.

New software updates, User Guide PDFs, and development tools such as APIs are freely available for download on our website.
Chapter 2

Installation

Installing the Gripper

This section describes how to install the Gripper on your ER1-A or ER1-K.

The Gripper Arm Kit comes with the following parts:

- One Gripper Arm Unit
- One Gripper bracket
- One hinge plate
- One 12" XBeam
- One set of three Allen wrenches
- The screws and nuts you need to attach the arm
- Documentation
- Software CD-ROM
There are two standard robot/arm configurations, each with two possible orientations (pincers horizontal or pincers vertical):

- Gripper Arm on at the top of the robot
- Gripper Arm on the side of the robot

Choose the configuration best suited to your needs. You can change the arm configuration at any time with just an Allen wrench.

**Gripper at the Top of the Robot**

**Step 1.**

**You need:**

- Your ER1

**Instructions:**

- Remove the set screws (16 total) from all locations on each of the 90° connectors (see arrows - not all set screws shown).
- Remove the camera assembly/XBeam unit.
- Save all of the set screws.
Step 2.

Instructions:

- Remove the set screws from the 135° connectors (see arrows - all sides not shown) and remove 2" XBeams.
- If you have a pre-assembled robot, you will have hinges at this junction. Unscrew the thumbnuts. Take the set screws out of the hinge halves and remove the 2" XBeams.

Step 3.

Instructions:

- Remove the set screws (4 total) from the gussets on both sides (see arrows).
- Important Note: Do not put any pressure on the camera, as it will snap off.
Chapter 2  Installation

Step 4.

Instructions:
- Remove the set screws (2 total) from the U-clip in the 7” XBeam (see arrows).
- Pull the 7” XBeam off of the U-clip in the 10” XBeam.

Step 5.

Instructions:
- Remove the set screws (2 total) from the bottom hinge half (see arrows).
- Unscrew the thumbnut and disassemble the bottom hinge half from the camera assembly.
- Pull the hinge half out of the 7” XBeam.
- Put the locking washer and the camera assembly in a safe place.
### Step 6.

**You need:**

- 1 Hinge plate
- 3 Allen screws
- 3 1-Holed T-nuts
- 10" XBeam with U-clip

**Instructions:**

- Add the Allen screws to the hinge plate, securing with the 1-holed T-nuts.
- Slide the T-nuts on the bottom of the hinge plate into the track of the XBeam as shown. There should be 2" between the edge of the hinge plate and the end of the XBeam.
- Tighten the Allen screws.

### Step 7.

**Instructions:**

- Remove the set screws from the U-clip.
- Slide the U-clip to line up with the hinge plate as shown.
- Re-apply the setscrews.
**Step 8.**

### You need:
- 12” XBeam
- 2 Gussets (4 Gusset halves)
- Set screws

### Instructions:
- Attach the 12” XBeam to the U-clip in the 10” XBeam and to the hinge plate as shown. Do this by sliding the 1-holed T-nut (in the top of the hinge plate) down the track of the 12” XBeam and then seating the XBeam on the U-clip. Add set screws to the U-clip and tighten.
- Press the gusset halves together and insert them as shown. Add set screws (4 total) to the gussets (see arrows).

**Step 9.**

### Instructions:
- 1 Gripper Arm Bracket
- 2 Allen screws
- 2 1-Holed T-nuts

### Instructions:
- Thread the Allen screws through the bracket in the positions shown.
- Attach the 1-holed T-nuts to the Allen screws.
- Slide the T-nuts down the track of the XBeam. Make sure that the bracket is positioned as shown. There should be 1” between the top of the XBeam and the edge of the bracket.
### Step 10.

**You need:**
- 1 Hinge half
- Set screws

**Instructions:**
- Add a hinge half to the top of the subassembly.
- Add set screws (2 total) on both sides of the hinge half (see arrows).

### Step 11.

**You need:**
- 2 90° connectors (4 halves)
- 2 2” XBeams
- Set screws

**Instructions:**
- Press the 90° connector halves together.
- Slide the assembled 90° connectors into the 10” Xbeam.
- Attach the 2” Xbeams to the ends of the 90° connectors as shown.
- Add set screws (16 total).
### Step 12.

<table>
<thead>
<tr>
<th>You need:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2 135° connectors (4 halves)</td>
</tr>
<tr>
<td>• Subassembly from the previous step</td>
</tr>
<tr>
<td>• Set screws</td>
</tr>
</tbody>
</table>

#### Instructions:
- Press the 135° connector halves together.
- Slide the connectors into the ends of the 2" XBeams.
- Attach the subassembly to the robot as shown.
- Add set screws to the 135° connectors (16 total).

### Step 13.

<table>
<thead>
<tr>
<th>You need:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 Camera subassembly</td>
</tr>
<tr>
<td>• 1 Philips screw and 1 thumbnut</td>
</tr>
<tr>
<td>• 1 Locking washer</td>
</tr>
</tbody>
</table>

#### Instructions:
- Align the hinge half on the bottom of the camera subassembly with the hinge half on the top of the 12" XBeam. Remember to place the locking washer between the two.
- Thread the Philips screw through the holes in the hinge halves and the locking washer.
- Add the thumbnut to the end of the Philips screw. Tighten with pliers.
**Gripper at the Top of the Robot**

**Step 14.**

<table>
<thead>
<tr>
<th>You need:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 ER1 Gripper Arm</td>
</tr>
</tbody>
</table>

**Instructions:**

- Attach the Gripper using the mounting pins as shown. Note that the Gripper can be positioned either horizontally or vertically depending on the mounting pins you use.
- Make sure to slide the pins back in the holes as shown. This helps to secure the arm.

**Step 15.**

<table>
<thead>
<tr>
<th>You need:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 Small Allen screw</td>
</tr>
</tbody>
</table>

**Instructions:**

- Insert the small Allen screw through the center hole in the in the Gripper bracket.
- Tighten the Allen screw.
- You have finished mounting your Gripper.
- Plug the power cord into the battery and the USB cable into the USB connection on your robot’s laptop.
- Next, you need to install the software.
Gripper Mounted on the Side of the Robot

Step 1.

Instructions:

- Remove the set screws in the bottom 135° connectors (see arrows - not all sides shown).
- If you have purchased a pre-assembled robot, you will have hinges with Philips screws and thumbnuts at this junction. Disassemble by loosening the thumbnuts and removing the screws.
- Remove the top of your robot.
- Remove the 135° connectors.
- Be careful with the camera, as it snaps off easily.
### Step 2.

#### You need:
- 1 ER1 Gripper Arm
- 1 Mounting bracket
- 2 Allen screws
- 2 1-Holed T-nuts

#### Instructions:
- Thread the Allen screws through the bracket as shown.
- Attach the 1-holed T-nuts to the ends.
- Attach the bracket to the Gripper at a 45° angle as shown.

### Step 3.

#### You need:
- 1 Small Allen screw

#### Instructions:
- Slide the mounting pins back into the smaller part of the holes as shown. This helps to secure the Gripper.
- Attach the small Allen screw to the bracket as shown. Tighten securely.
## Chapter 2 Installation

### Step 4.

**You need:**
- Subassembly from the last step
- Your robot

**Instructions:**
- Slide the 1-holed T-nuts down the track of the 12" XBeam on the side of your robot. Position it about 1" above the strut.
- Tighten the Allen screws.

![Strut Image](image)

### Step 5.

**You need:**
- The top of your robot
- Set screws

**Instructions:**
- Reattach the top of the robot.
- Add set screws on the 135° connectors (see arrows - all sides not shown).
- If you have a pre-assembled robot, reassemble the hinges and tighten with pliers.
- You have finished mounting your Gripper. Plug the power cord into the battery and the USB cable into the USB connection on your robot’s laptop. Next, you need to install the software.
Installing the Software

The Gripper requires the installation of a new release of the ER1 RCC software version 1.1.0. If this is the first time you are installing ER1 software on your robot’s laptop, follow the instructions below (to update your existing ER1 software, see the next set of instructions):

1. Close all programs.
2. Put the CD in the laptop’s drive. The installation should initiate automatically.
3. If the Robot Control Center (RCC) software installation does not start automatically, you can start it from the CD. Different Windows platforms let the user do this in different ways. Here’s how to do it in a Windows 2000 environment:
   • On your Windows desktop, click on the Start button.
   • Choose Run.
   • In the pop-up window, use the Browse button to navigate to the directory for the CD-ROM drive.
   • In the top-level directory, double-click on the file setup.exe.
   • There may be a dialog box telling you to reboot before the installation. Click Yes and the installation should automatically continue after the reboot.
4. The software installation should start automatically, if your computer uses Microsoft’s autorun feature. Click Next to proceed through the installation. You may click on the Cancel button at any time to stop the installation.
5. The ER1 Robot Control Center Licensing Agreement will be displayed and you will be prompted to accept/reject it. Click Next.
6. The Release Notes will be displayed. Make sure to print these out and read them. They contain information that cannot be found in the ER1 User Guide. Click Next.
7. You will be prompted to accept/reject the usual setup options for destination folder. Click Next.
8. Typical/custom install - You will also be prompted to choose a type of installation. Usually you should select Typical. Click Next.
9. A message is displayed: Ready to Install. Click Next. Wait while the system copies files for installation.
10. The software will confirm that your computer has the latest version of DirectX installed. The ER1 software requires version 8.1 or newer.
11. If necessary, you will then be prompted to install DirectX 8.1. Click Yes.
12. You will then be shown the Microsoft license agreement for DirectX and you will be prompted to accept/reject it. Click Yes.
13. A popup dialog may be displayed asking you to reboot your computer. If so, select Ok to reboot and then click Finish.
14. Reboot your computer. (If it does not reboot automatically, please reboot manually.)
Chapter 2 Installation

15. After the installation is complete, a shortcut icon for the ER1 Robot Control Center software will appear on your desktop. Double-click on it to start the ER1 application.

16. **Important Note:** You should always start the software from the RCC icon or from the installed destination directory. Otherwise, the software may not be able to find all the associated files it needs to operate correctly.

17. You should be able to click on the gripper icon on the lower left side of the RCC screen to cause the gripper to open and close. This verifies that the gripper was installed correctly.

18. For remote operation, install the ER1 RCC software onto your client PC as well. The software license permits this.

**Important Note:** The robot’s battery must be switched on in order to use the Gripper.

### Updating Existing Software

The Gripper requires the installation of a new release of the ER1 software version 1.1.0. (If this is the first time you are installing ER1 software, see the previous instructions.) Follow the instructions below to update your existing ER1 software:

1. Close all programs on your robot’s laptop.
2. Put the CD in the laptop’s CD-ROM drive.
3. The software update package from the CD will automatically open to the Install Wizard if your computer uses Microsoft’s autorun feature. If it does not, use the following procedure:

   Different Windows platforms let the user do this in different ways. Here’s how to do it in a Windows 2000 environment:
   - On your Windows desktop, click on the **Start** button.
   - Choose **Run**.
   - In the pop-up window, use the **Browse** button to navigate to the directory for the CD-ROM drive.
   - In the top-level directory, double-click on the file **setup.exe**.
4. The Install Wizard will direct you to close all programs. If you have not done this, do so now. Click on the **Next** button.
5. Read the License Agreement. If you decide to accept the License Agreement, click on the **I accept the license agreement** button. Then click the **Next** button. If you choose not to accept the License Agreement, leave the **I do not accept the license agreement** radio button selected. Click **Next**. The installation will be terminated. See the **Customer Support** section for contact information.
6. If you accepted the License Agreement, the Release Notes will be displayed next. Read the Release Notes carefully, as they contain information that is not available in the **ER1 User Guide**. Click on the **Next** button.
7. Select the destination folder for the ER1 RCC program. The default value is C:\Program Files\ER1\. To accept the default, click Next. If you would like to select a different directory, use the Browse button.

8. Select a Typical installation. Click the Next button. Click Next again. The installation will begin. This should only take a few minutes.

9. If you selected a Typical installation, you will be prompted to install Microsoft DirectX. Click Yes. Read the DirectX license agreement carefully and then click Next.

10. When DirectX has successfully installed, a dialog box announcing this will appear. Click Ok.

11. The installation will continue. When it has completed, click on the Finish button.

12. The ER1 RCC software is now installed on your computer. Note: If you plan on using a wireless network, repeat this process on your remote computer.

13. Reboot your computer.

14. After the installation is complete and you have rebooted, the shortcut icon for the ER1 RCC software will now start the new version of the application. Double-click on it to start the ER1 application.

15. Important Note: You should always start the software from the RCC icon or from the installed destination directory. Otherwise, the software may not be able to find all the associated files it needs to operate correctly.

16. You should be able to click on the Gripper icon on the lower left side of the screen to cause the Gripper to open and close. This verifies that the Gripper was installed correctly.

Important Note: The robot’s battery must be switched on in order to use the Gripper.
Chapter 2  Installation
Chapter 3

Using the Gripper

Using the Gripper

The ER1 Gripper Arm can be operated in a number of different ways:

- Independent operation using the Gripper’s IR sensor
- Manual operation during remote control of the robot
- As part of a behavior sequence
- USB joystick control
- Through the ER1 Command Line Interface
- Pressing the Open button on the Gripper motor enclosure

*Important Note:* The ER1 Gripper Arm can always be opened by pressing the **Open** button on the motor casing. The Gripper will make noise. This is normal. Note that the open/close action is not linear. Slider action runs for several seconds before the Gripper actually opens or closes. Never squeeze an open Gripper closed. This will damage the Gripper.
Independent Operation of the Gripper

The Gripper is designed to operate under software control, but can also operate independently of software control.

For independent operation, you do not need to plug the arm’s USB cable into the laptop. Just plug the power cord into the robot’s battery.

When an object breaks the beam between the robot Gripper’s IR sensor and receiver, the pincers will automatically close. It will continue to grip the object until you do one of two things:

- Pull the object out of the Gripper by grasping the object and pulling straight out.
- Press the Open button on the back of the gripper. This will cause the Gripper to open, so remember to grab the object first so it doesn’t fall to the ground.

Remote Operation of the Gripper

The Gripper can be commanded to open and close remotely through the ER1 Robot Control Center (RCC) software.

The Gripper control is located in the lower left corner of the display, near the navigation controls.

The icon on the Gripper button indicates the state of the gripper. If the icon shows an open Gripper, then the Gripper is currently open. Clicking on the button will cause the Gripper to close and the icon to change to that of a closed gripper, shown on the left. A grayed-out icon means that no gripper was detected.

With remote operation (using a wireless connection), you can:

1. Use Teleoperation to drive the robot up to the object to be gripped, maneuvering so that the object is within reach of the Gripper.
2. Click the Gripper button to cause the gripper to close or (use the Settings menu to set the Gripper to close automatically when the IR beam is broken).
3. Drive the robot to the object’s destination.
4. Click the Gripper button to release the object.

Gripper Settings

The Settings menu has a Gripper tab that can be used to control the way the gripper works while behaviors are running, and when they are not running.

- **Automatically grasp objects when not running behaviors** - This checkbox, if selected, specifies that the gripper, when a behavior is not running, should close when the IR beam is broken. This option is selected by default.

- **Automatically grasp object when running behavior sets which do not use the gripper** - This checkbox, if selected, specifies that the Gripper should grasp any objects that trigger the IR sensor when a behavior that does not use the Gripper is running. This option is selected by default.
The ER1 RCC software now allows you to control your robot and your Gripper by using a USB compatible joystick. ER1 supports the following joystick operating configurations:

- Wireless remote joystick communicating directly with the robot’s laptop.
- Standard cable joystick plugged directly into the robot’s laptop.
- Wireless remote joystick communicating directly with the remote client, which is in turn remotely controlling the robot’s laptop.
- Standard cable joystick plugged directly into the remote client, which is in turn remotely controlling the robot’s laptop.

Almost all USB joysticks are supported by the ER1 software, including:

- Logitech WingMan® Cordless Rumblepad
- Microsoft® Sidewinder® Joystick
- Belkin Nostromo N40 Gamepad
- Ken Eliminator Gamepad Pro
- Microsoft® Sidewinder® Game Pad PNP

### Joystick Parameters

There is a **Joystick** tab in the **Settings** menu and another one in the **Behavior Settings** menu to allow you set joystick controls for global (applies to all behaviors) or behavior-specific operations, respectively.
Note that you must have the joystick connected to your computer (by cable or wireless hookup) before you can specify these joystick options. Joystick installation and set-up is generally very easy. Refer to the instructions included with your joystick.

**Settings Menu**

Options are:

- **Enable Joystick Control**: This checkbox, if selected, allows you to use a joystick to control your robot, including controlling the Gripper open/close function. Note that when the joystick is enabled (or at startup), if the current joystick position will result in robot motion, you will be asked if you want to enable joystick control. Note also that some joysticks have more than just X,Y control. For example, the Logitech WingMan Cordless Rumblepad joystick has two independent joysticks which control the X,Y and R,U axes. By adjusting the Axis menu settings, you can make either the right or left joystick control the robot, or split the motion so that, for example, the left joystick controls turning and the right one controls linear motion.

- **Joystick number**: Use this pulldown menu to specify a joystick number. The first joystick installed on your PC is considered Joystick 1 and the second is Joystick 2, etc. You can only use one joystick at a time with the ER1.

- **Axis**: These parameters specify the kind of motion to be assigned to the joystick(s) or the joystick buttons.
  - **Angular Axis**: This is the left / right motion of the robot.
  - **Linear Axis**: This is the forward / backward motion of the robot.
  - With the joystick enabled, the user can reverse, if needed, the control axes on the joystick map. To do this, just check the appropriate Reverse checkbox.
Joystick Parameters

- **Graphic Display**: To illustrate what effect your axis settings will have on the robot’s movements, the square graphics box on the right hand side of the menu displays a red '+' which moves in response to your joystick commands to simulate the resulting robot movement.

- **Button Commands** - Use this to assign robot actions to the joystick buttons.

- **Button number**: You can select the joystick button number in the pulldown menu. You can also click in the textbox then press the joystick button and the correct button number will be selected automatically. See your joystick documentation for information on button number assignments. Choices of actions to associate with buttons are:
  - **Do nothing** - No button assignment.
  - **Close gripper** - Closes the Gripper.
  - **Open gripper** - Opens the Gripper.
  - **Run behaviors** - Equivalent to clicking the Run it button for the presently loaded behavior sequence. If this button on the joystick is pressed, the robot will wait for the pre-programmed trigger condition, for example, seeing a specific color. It will then will trigger the corresponding actions.
  - **Stop behaviors** - Equivalent to clicking the Stop button for the presently running behavior sequence.

All of the above settings are stored on the computer to which the joystick is attached, in that computer’s `er1.ini` file.

**Behavior Settings Menu**

You can also assign a specific behavior to be triggered by a joystick button press. This feature is accessed by the **Behavior Settings** in the **Joystick** tab. This means that the button press itself is the trigger condition, causing the immediate triggering of the programmed corresponding actions. (As differentiated from the **Settings menu>Joystick tab>Button commands>Run behaviors** choice, which simply tells the ER1 to start monitoring for a programmed trigger condition.)

To use this function, select the **Trigger active behavior on joystick button press** checkbox. You may select a button to trigger a behavior by using the pulldown menu. Or, as for the **Settings menu**, you can click in the textbox, then press the desired joystick button. That button number will be displayed in the pulldown menu.
Important Note: The same joystick button can be used to start behaviors (configured in the Joystick tab of the Settings menu) and to trigger a behavior (configured in the Joystick tab of the Behavior Settings menu). If you set it up this way, you can, for example:

1. Open a new behavior set.
2. Click the Behavior Settings button to display the Behavior Settings menu, then click on the Joystick tab.
3. On your joystick, press button 1. This tells the ER1 to trigger Behavior 1 immediately when button 1 is pressed. (Remember, the behavior still has to be in the Run it state for the trigger to be recognized. If you pressed the button at this point, nothing would happen, because no behavior was waiting for the trigger condition.) Click Ok.
4. Click on the Settings button to display the Settings tab, then click on the Joystick tab.
5. Click on Enable joystick control. (The active behavior is the behavior that is presently displayed in the GUI. For a new behavior set, this is Behavior 1.)
6. In Behavior 1, go to the Then column. Select the Play a Sound checkbox. Type in “Hello, I’m the ER1” in the Speak a phrase textbox.
7. Use the joystick as usual to command the robot to move.
8. When you would like the robot to speak your phrase, press Button 1.
9. This will trigger the active behavior, causing the robot to speak the phrase you typed in.
10. If you’ve got your Behavior Settings configured so that the behavior runs only once, the behavior will consider itself complete, performing the equivalent of clicking the Stop button on the GUI.
11. You can continue to use the joystick to drive the robot. Just press Button 1 again when you want it to speak the phrase you programmed.

**Important Note:** While the behavior is running, the joystick will not move the robot. This behavior is analogous to the arrow keys or the movement buttons on the GUI.

Remember, the joystick commands are passed over remote control, so you can drive a robot using a joystick connected to your remote control system (without the need for a wireless joystick).

**Programmed Behavior Operation of the Gripper**

The Gripper Arm can be commanded to open and close as part of a behavior sequence in the ER1 Robot Control Center Software and movements can be programmed to stop if the Gripper IR (infrared) LED beam is broken.

The **If** column contains the following Gripper triggers:

- **Object enters gripper** - The behavior will be triggered when an object is detected entering the gripper. Note that this does not close the Gripper, it simply triggers the action(s) specified. If you would like the Gripper to close, specify this in the **Then** column.

- **Gripper is opened using push button** - The behavior will be triggered when the button on the Gripper is pressed.

Note that the objects are detected using the Gripper’s IR LED.
The **Then** column contains the following **Gripper** actions:

- **Open gripper** - Open the Gripper if the trigger condition is met. (Remember, this will cause an object within the gripper to fall from the gripper’s grasp.)
- **Close gripper** - Close the Gripper if the trigger condition is met.

**API Operation of the Gripper**

The Gripper Arm can be commanded to open and close and report status through the supplied Command Line API command:

```
gripper <action>
```

Where `<action>` is one of:

- auto
- close
- open
- status
- stop

The API also allows you to read the state of the gripper using the `sense gripper` command.

All of these commands are described in detail in the sections that follow.

**Gripper Auto**

**Usage**

```
gripper auto
```

**Description**

This command sets the Gripper so that it will close when the IR beam from the IR LED is broken.

**Parameters**

None.

**Returned Values**

None.
API Operation of the Gripper

Gripper Close

Usage
   gripper close

Description
This command closes the Gripper.

Parameters
None.

Returned Values
None.

Gripper Open

    gripper open

Description
This command opens the Gripper.

Parameters
None.

Returned Values
None.

Gripper Status

Usage
   gripper status

Description
This command returns the status of the Gripper.

Parameters
None.

Returned Values
The message returned is in the format:

   OK {position} {object status} {auto status}
where \textit{position} is one of:

- open
- closed
- opening
- closing
- unknown (not fully open or closed)

and \textit{object status} is one of

- empty
- full
- unknown (IR LED beam is off)

and \textit{auto status} is one of

- auto
- manual

### Gripper Stop

**Usage**

```
gripper stop
```

**Description**

This command stops the Gripper from moving. It will also take the Gripper out of auto mode. (See \texttt{Gripper Auto} for details.)

**Parameters**

None.

**Returned Values**

None.

### Sense Gripper

**Usage**

```
sense gripper
```

**Description**

This command checks to see what the Gripper is doing at that moment.

**Parameters**

None.
Other New Features of ER1 RCC 1.1

• Returned Values
  • gripper opened - Gripper finished opening.
  • gripper closed - Gripper finished closing.
  • gripper filled - Object has entered the gripper.
  • gripper emptied - Gripper opened via the Open button on the motor enclosure.

Other New Features of ER1 RCC 1.1

• Redesigned GUI with:
  • Reset button for X, Y coordinates
  • Redesigned Navigation control
  • Multiple object selection for Sight triggers
  • The Then column Move section has been restructured for easier programming.
  • The If column Time area has a new seconds setting.
  • New log messages instead of pop-up windows
  • New speed settings
  • New If / Then Activation
  • New Remote Control Indicator

Important Note: Behaviors created or opened in ER1 RCC version 1.1.0.85 or above cannot later be opened in an earlier version of the RCC software. Behaviors created in versions earlier than 1.1.0.85 will run if opened in version 85 or later.

If/Then Activation

You no longer need to click on a checkbox to enable a trigger or action to be programmed. Just click in any textbox or pulldown menu within the section’s area and the checkbox will automatically be checked.

To disable a programmed trigger or action, you still need to click on the checkbox, but the active click area has been enlarged to include the checkbox’s label. For example, click on the word Sight next to the Sight checkbox to enable or disable this trigger.

Remote Control Indicator

The GUI now displays remote control status on the right side of the title bar. The status messages are:

• Remotely Controlling the Robot - The RCC software on this machine is displaying the settings of the remote robot’s laptop, and can be used to control that laptop.
• **Under Remote Control** - The RCC software on this machine is displaying the settings of this machine. However, another instance of ER1 on a remote computer is remotely controlling the robot to which this laptop is attached.

• **Under API control** - The RCC software on this machine is under API control.

• **Not connected** - The wireless network between the remote machine and the robot is not connected.

• **Local Control** - The RCC software on this machine is displaying the settings of this machine.

### Redesigned Navigation Controls

The navigation controls on the bottom left side of the RCC software have been changed from four directional button controls to one “joystick-like” directional selector.

Click the mouse button on the big center circle and hold the button down while dragging the directional “joystick” in any direction to cause the robot to move in the corresponding direction.

- Pointing the joystick at the dot in the middle of the top or bottom triangle moves the robot forward/backward.

- Pointing the joystick at the dot in the middle of the right or left triangle sends the robot into a clockwise or counterclockwise spin.

- Pointing the joystick at any other area on the Navigation control causes the robot to move on a curved path.

You can vary the robot’s speed at the same time by dragging the “joystick” to make it longer (causing the robot to move faster) or shorter (causing the robot to move more slowly).

### Time Setup Redesign

The **Time** set up on the GUI has been redesigned for ease of use. Note that the time you specify is a start time. Behaviors will be repeated at the specified interval after that. If no start time is specified, the behavior will begin when the **Run it** button is clicked. Here it is:

• **Hours** - This pulldown menu specifies the hour at which to start. You must select a value for this field.

• **Minutes** - This pulldown menu selects the number of minutes. If you do not select a value for this field, 00 is assumed.

• **Seconds** - This pulldown menu specifies the number of seconds. If you do not select a value for this field, 00 is assumed.

• **A.M. or P.M.** - Use this pulldown menu is used to select A.M. or P.M. You must select a value for this field.

• **Frequency (once, daily, weekly, etc.)** - Use this pulldown menu to select the frequency with which the ER1 should perform a given task. Remember to set the
Let this behavior run more than once parameter in the Behavior Settings menu to on if you want this behavior to run more than once. If you do not select a value for this field, “Once” is assumed.

Important Note: If you accidentally forget to set a required field, when you click the Run it button, you will get an error message telling you that there is either no trigger condition, or the condition is incomplete. You can refer to the log for specific information on what is missing.

Reset X,Y Coordinates

The X and Y coordinates displayed in the bottom left side of the GUI show the robot’s movements relative to its starting position.

You can now press the Reset button next to the coordinate text boxes to re-zero the counters.

Informational Pop-up Windows Redirected

A pop-up window is no longer displayed when the information is of an anecdotal nature only.

For example, the message “All behaviors are completed” had been displayed in a pop-up window that required you to click Ok before continuing to interact with the ER1. Now, that information is written only to the log, eliminating the need for user interaction.

Other messages moved to the log from pop-ups:

- “Cannot connect to the robot hardware”
- "Cannot save settings to remote host because the connection is down"
- "Warning: no cameras found"
- "Error opening camera"
- "No camera present"
- "<Behavior> does not specify any actions or the actions are all incomplete"
- "Connected to remote system at address <IP address>"
- "You have successfully disconnected from <IP address>"
- “No joysticks found"
- "The robot sent a corrupted image"
- "The robot is unable to capture an image in its current state"
- Various messages which come from the robot hardware when under manual control (such as "Cannot connect to the robot hardware").

Speed Settings

The Motion tab of the Settings menu has the speed settings that are now used as the upper limit for all movement-related GUI activities - arrow keys, joystick and simulated joystick. Any of these parameters can be selected using the pulldown menu provided.
There is also now a **Speed** option in the **Motion** tab in the **Behavior Settings** menu for X,Y motion for both angular and linear velocity.

### Multiple Sight Selections

You can select multiple objects as triggers for the same behavior. Each saved object in your object library is now displayed with a checkbox on the left hand side. Click the **Object**’s radio button to specify it as an action trigger. You can now select/deselect one or multiple objects, the recognition of any one of which will trigger the programmed action.

There is a new read-only text box, which provides a count of the number of selected objects. There is also a **Clear** button, which deselects all the checkmarks at once.

### Move Section Changes

Extensive changes have been made to the **Move** section of the GUI. These include:

- Eyedropper feature added to the color bar
- Ability to select “Same color as for Sight”
- Gripper action support
- X,Y programmable movement support

### Dropdown Menu

The **Move** area now only displays the settings for one type of motion at a time.
Important Note: UNPLUG THE LAPTOP'S CHARGER BEFORE INSTRUCTING THE ROBOT TO MOVE. The robot should detect whether or not the laptop is plugged into a wall outlet and should not move until the laptop is unplugged. However, take care to ensure that the laptop is unplugged, because if the robot fails to detect that the laptop is plugged in, it will move in response to your commands until it reaches the limit of the laptop's power cord, then will continue to try to move, potentially damaging the laptop, the laptop's charger, the robot, and the electrical outlet. This could start an electrical fire.

To switch between the motion types, use the pull-down menu. You can choose among:

**Drive Toward Color**

When set, this parameter tells the robot to drive forward towards the color you specified using the color selection tool. Tell the robot when to stop by specifying percent of the screen that should be filled with the specified color. This action is considered complete when one of the following two conditions are met:

- The robot drives toward the specified color or object and successfully stops when the percent of the screen specified by the user is reached.
- The robot fails to see the color after 30 seconds.

**Drive toward object**

When set, tells the robot to drive forward towards the **Object** specified in the text pull-down menu. Tell the robot when to stop by specifying a distance and units. Note that the robot will not move until a value greater than 5cm or 2" is specified. This action is considered complete when one of the following two conditions are met:

- The robot drives toward the specified object and successfully stops at the distance specified by the user.
- The robot fails to see and drive toward the specified object after 30 seconds.

**Rotate toward color**

When set, tells the robot to rotate towards the color you specified using the color selection tool. Tell the robot when to stop by specifying percent of the screen that should be filled with the specified color. This action is considered complete when one of the following two conditions are met:

- The robot rotates toward the specified color and successfully stops when the percent of the screen specified by the user is reached.
- The robot fails to see the color after 30 seconds.
Rotate toward object

This parameter, if set, tells the robot to rotate until it sees the object you specified using the Object pulldown menu. This action is considered complete when one of the following two conditions are met:

- The robot rotates and successfully finds the specified object, then stops when facing the object.
- The robot completes a 360° rotation and fails to spot the specified object.

Distance

This parameter is used to specify a distance that the robot should move when the behavior is triggered. In the This Amount textboxes you can specify a number and unit for the distance. In the This Direction pulldown menu, select a direction.

This action is considered complete when one of the following condition are met:

- The robot moves the distance specified.

Angle

This parameter sets the robot to turn when the behavior is triggered. In the This Amount textbox, specify the number of degrees that you would like the robot to turn. In the this direction pulldown menu, select right or left.

This action is considered complete when the following condition is met:

- The robot turns the specified number of degrees.

Relative position

This is a new feature. You can now program the robot to perform a measured movement along both the x and y axes (forward/backward and left/right).

This action is considered complete when the following condition is met:

- The robot moves the specified distance.

Stop on Sensor

For all of the Move types, you can specify that the robot motion should stop if a sensor detects something. Presently, the only sensor you can choose is the Gripper IR sensor. If Stop on Sensor is checked, then the robot’s motion will terminate as soon as an object entering the gripper claw triggers the IR sensor to begin closing the claw.
**Choose Color**

The **Sight** and **Move** color bars both have an addition to the submenu that pops up when you click on the eyedropper. You can now specify **Use same color as Sight** or **Use same color as Move**, whichever is appropriate. If no color has been specified, no button will be displayed.
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