Revel Robot Pick n′ Drop Exhibit User Guide

SVENZVA ROBOTICS

Foreword

From everyone at Svenzva Robotics **thank you** **for your purchase of the Revel Pick n' Drop Exhibit** and doing your part in providing access to robotics to the general public.

This guide is designed to familiarize users with the safety features of the robot, general operation of the exhibit, and troubleshooting methods in the event something goes wrong.

A digital, full color version of this document is available on our website at **http://svenzva.com/support/** under 'Downloads'.

Disclaimer

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Chapter 1

Exhibit Overview

The Revel robot has a number of safety features that keeps itself and the exhibit safe. In this chapter, we explore the components and safety features of the Revel Pick n' Drop Exhibit.

1.1 Exhibit Components

The Pick N' Drop Exhibit has several central components: the Revel robot arm, the 4.5' x 3' enclosure, and associated electronics (PC, controller, surge protector)

The enclosure has two access panels: a lower panel that allows access to the electronics and an upper panel that allows access to the robot and the exhibit contents.

Each access panel has the ability to be locked and secured, which Svenzva **strongly** recommends.

1.2 Robot Safety Features

1.2.1 Software

The Revel Robot has been extensively engineered by Svenzva Robotics to be safe and situationally aware once the robot is turned on in a known position.

The robot is fully aware of its own position and knows of obstacles in its environment including walls and the ground plane. The robot is configured to stay a specified distance away from all obstacles, overriding user input in situations

where it is near an obstacle.

Further, the robot is designed to stay within certain ranges for each motor, depicted in Figure 1.1. Svenzva's control software ensures compliance to these ranges.

This **dynamic control** allows users to direct the robot with the provided controller but allows the robot to prevent movements that may cause damage.

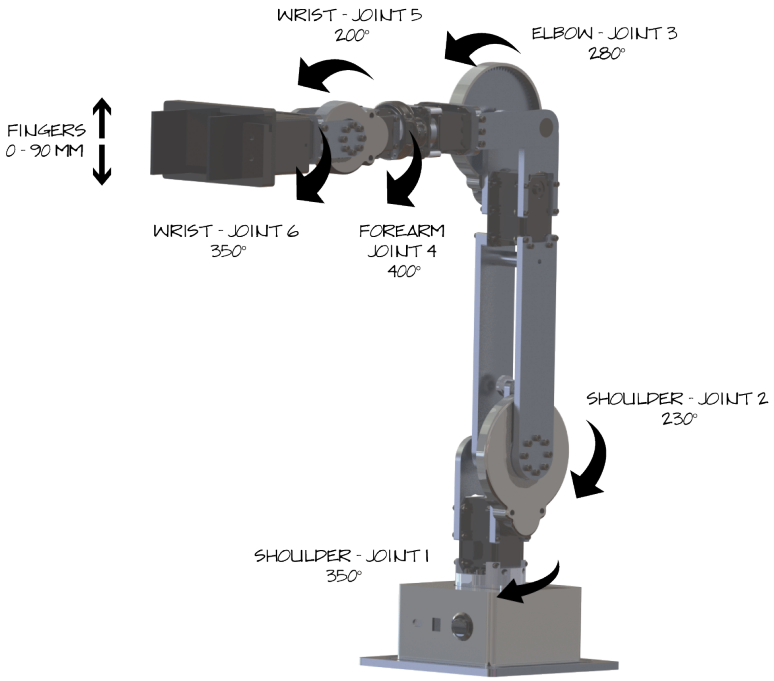

Figure 1.1: Revel robot arm joint limits

Electrical

The motors of the robot have low level safety mechanisms. These include

- Temperature monitoring - any motor that reaches a critical temperature will automatically shut off and go into Temperature Protection Mode
- Torque / Shock monitoring - any motor that is applying too much torque as to damage the motor will automatically shut off and go into Torque Protection Mode

The two conditions above are designed and configured not to trigger under normal operating conditions. These are a 'fail safe' and should only trigger in circumstances in which the primary safety mechanisms fail.

Chapter 2

Exhibit Operation

This chapter goes through the process of starting the exhibit's components and operational tips.

Svenzva Robotics has made this process as simple as possible. All it takes is lining up the robot, two button presses, and Svenzva's engineering takes care of the rest automatically.

2.0.1 Leaving the Robot on Overnight

Leaving the Robot and PC on overnight is technically possible, but it does cause premature wear on the arm's motors.

If possible, Svenzva recommends turning the robot and its computer off after use is done for the day and starting the exhibit the following day.

2.1 Turning on the Robot

The only subtle part of the process is that the robot needs to be turned on in a certain position. This position does not have to be exact, but it does need to be in an acceptable range or else the safety features put in place no longer work. In this event, the robot will very likely run into its environment, harming itself.

2.1.1 The Magic Position

In Figure 2.1 the robot is broken up into the different sections that we'll focus on orienting correctly.

In the following descriptions, we'll assume you're looking at and interacting with the robot from the rear access panel, with the robot's power button facing you.

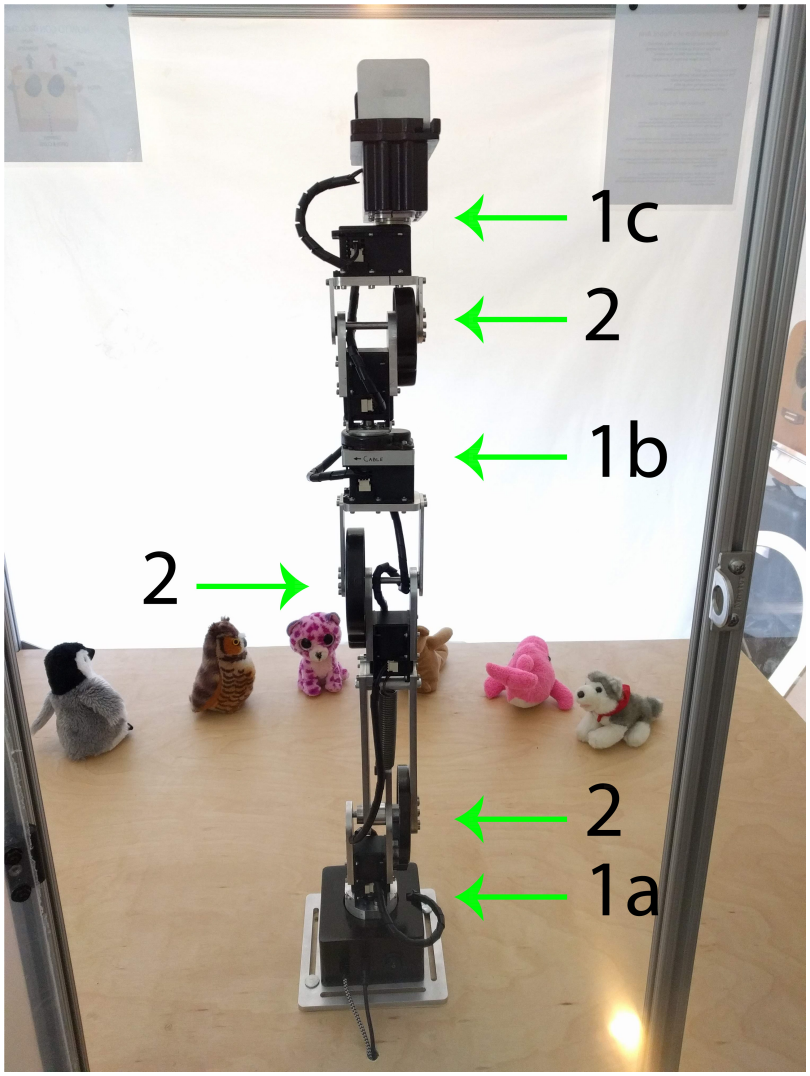

Figure 2.1: Overview of the different joints on Revel robot

Joint type	Placement description	Reference images
1a	first gear cover on right, second gear cover on left. Cable comes up through box to motor in front of you	Figure 2.2
2	All these joints just need to be lined up to be roughly straight up	Figure 2.2
1b	The top most gear cover should be on the right, and the cable should curl around the left to the next motor	Figure 2.3
1c	Align the two marks on the gripper and bracket for Joint 6 so the gripper's ribbed surface faces you. The cable should curl up and to the left.	Figure 2.4

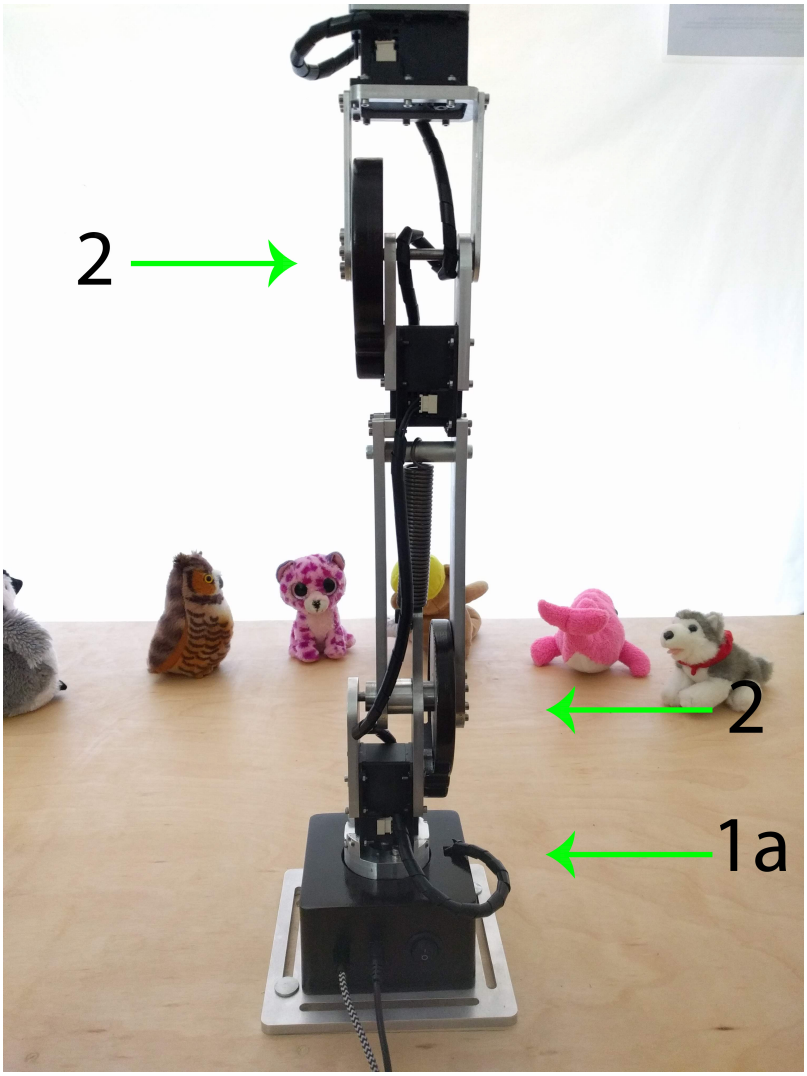

Figure 2.2: Close ups of sections 1a and 2

Line up the gear covers on the actual robot exactly as shown in Figure 2.1, ***taking note of the direction and position of the cables***.

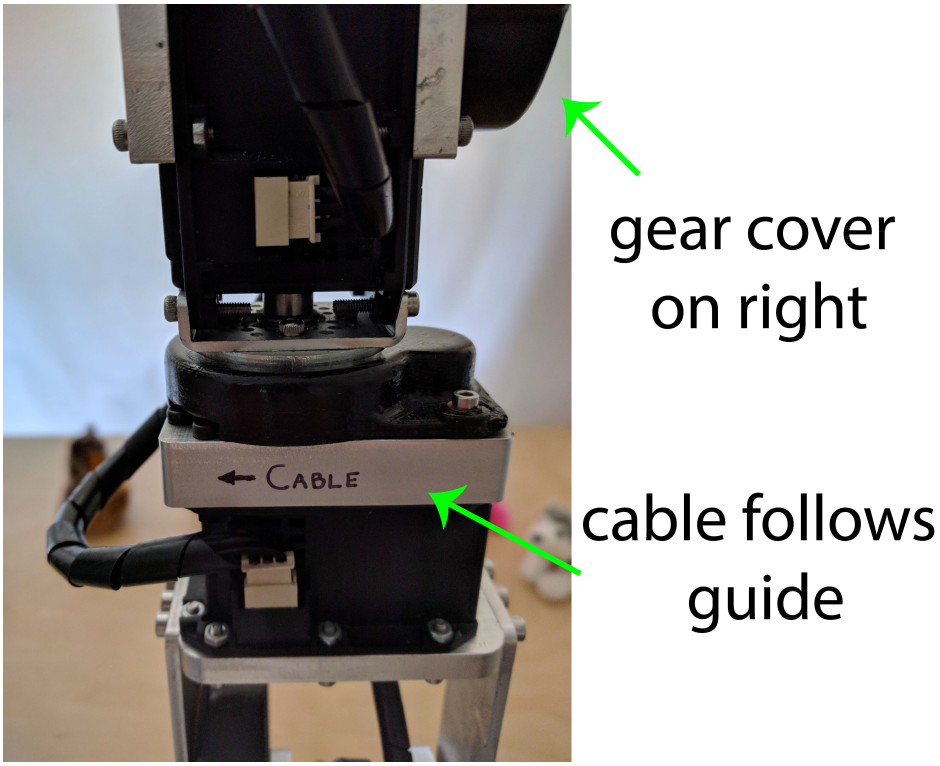

Figure 2.3: Close ups of section 1b

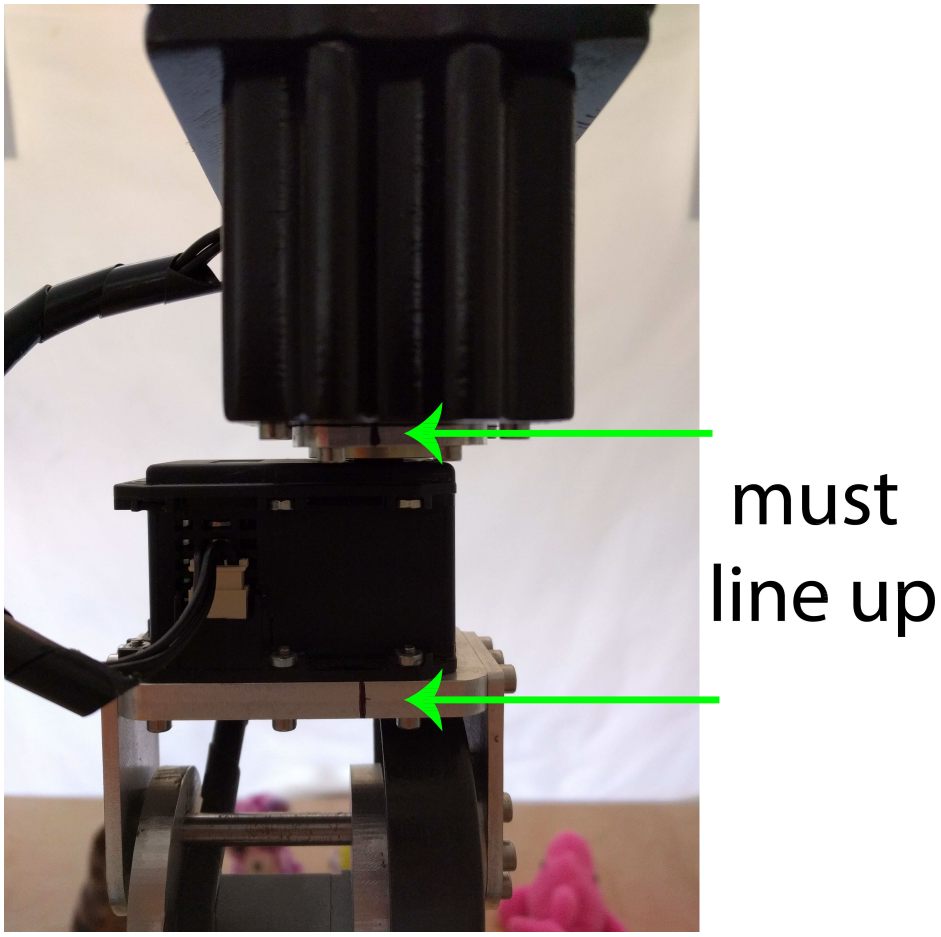

Figure 2.4: Close up of section 1c

2.1.2 Turning on the Power

After double checking the robot's starting position, you can flip the switch on the robot's electronic box to 'ON' or '1'. Note that the robot must be in position ***BEFORE*** the power is turned on.

See Figure 2.5 for reference of the electronics box.

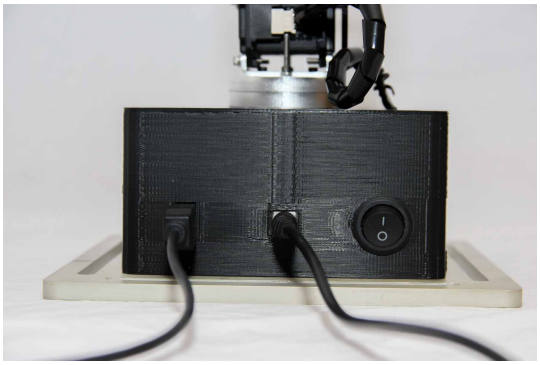

Figure 2.5: Correct attachment of the USB and power connectors on the electronics box

2.2 Turning on the PC

To turn on the PC, simply open the lower access panel and press the power button on the cube-shaped computer. The computer should light up slightly, indicating that it is booting up.

2.3 Putting It All Together

The order of operations to turn on the exhibit from scratch is this:

- Open the upper access panel and align the robot as specified in subsection 2.1.1
- Flip the robot's power switch (Section 2.1.2)
- Open the lower access panel and turn on the PC (Section 2.2)
- Lock both access panels

The PC and robot will communicate and boot up over the next 45 seconds. After this time, the robot is ready to be moved with the joy stick controller.

2.4 Verifying the Robot is Initialized Correctly

You can test that the robot has been started correctly by interacting with the robot and looking for specific behavior.

2.4.1 Ensuring the Robot is Collision Aware

There are two positions you can move the arm to ensure the robot's collision aware systems are fully functional.

During both tests, move the arm slowly. In the event that the collision systems are not functional, this will reduce the chance of moving the arm too quickly into an obstacle.

Svenzva does not recommend moving the robot completely into any obstacle. If any of the following tests fail, turn off the exhibit, ensure the robot is starting in the correct position, and turn the exhibit back on.

Move the arm towards the ground

Use the controller and attempt to move the robot into the ground plane. The robot should prevent movement beyond a couple inches above the plane as in Figure 2.6.

Figure 2.6: The robot prevents movement above the ground

Move the arm towards the back wall

Use the controller and attempt to move the robot into the back wall. The robot should prevent movement beyond half a foot away from the back wall as in Figure 2.7.

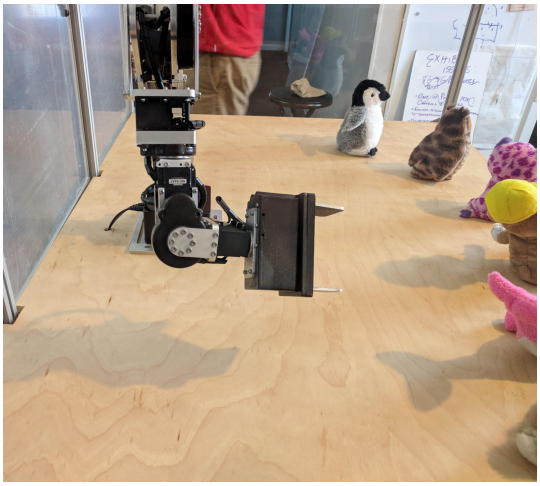

Figure 2.7: The robot prevents movement into the back wall

2.4.2 Turning the Exhibit Off

When you turn the exhibit off, open the back access panels. The two shutdown procedures are as follows.

Turning off the robot

If the arm is not in the upright position, be prepared to 'catch' it, as it may naturally move under its own weight when power is removed. Flip the power switch to 'OFF' or '0'.

Move the robot into an upright position where it can support itself under its own weight.

Turning off the computer

Turn off the computer by pressing the computer's power button once. The computer's power LED should turn off within the next 30 seconds. If it does not, you can hold down the power button until the PC shuts off.

Chapter 3

Troubleshooting

The Pick 'N Drop Exhibit has been rigorously tested. None the of the scenarios presented in this chapter are expected to happen.

However, in the interest of full preparation, this chapter explores possible events that may cause the robot to act different than expected and possible ways to resolve the behavior.

3.1 Getting the Robot Back Up and Running Quickly

If you can tell visually or audibly that the robot has an issue, the fastest way to get things back in order should be to reset the robot and computer. To do this, simply turn the exhibit off (as in Section 2.4.2) and turn it on again as specified in Section 2.3.

If the robot continues to misbehave or you're interested in resolving a specific issue: read on.

3.2 Cause & Effects

There are certain situations in which the robot will not recover from a simple reset. We explore these here.

3.2.1 Motor Does Not Seem to Move / Motor Has Red LED Blinking

As part of the lower level safety features, a motor may go into a Temperature or a Torque fault mode for self preservation.

If a motor is in this mode, reseting the robot will get everything in proper order. If the motor continues to flash red after a reset, see Section 3.2.2.

3.2.2 Motor is Shorted or Broken

Each motor has an LED window towards the top of its back panel. If the motor has non-repairable hardware issues, this LED will blink red continuously, even after robot resets.

If this happens, contact Svenzva support.

3.2.3 Fingers Have Been Removed from Robot Gripper

If the fingers of the gripper have somehow been removed from the gripper, you can attempt to insert them back **if the robot's gripper has not been opened/closed since the fingers have been dislodged**. If a user has pressed the 'Gripper open/close' button since the fingers were removed, the gripper is no longer calibrated.

In both cases, reach out to Svenzva support at support@svenzva.com.

3.2.4 Motor Communication Wire Has Been Unplugged

This is possible when an exhibit item gets hooked on a communication wire. This is most likely to happen on from Motor 4 to Motor 5 or Motor 6 to Motor 7 (inside the gripper housing).

In this event, locate the loose end of the communication wire and seat it fully into the connector housing on the motor as seen in 3.1. Then reset the robot and PC.

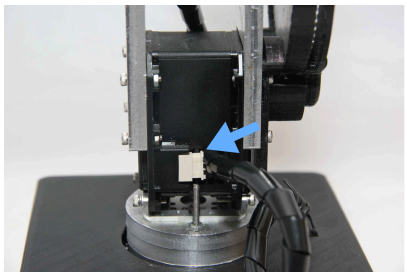

Figure 3.1: Install the cable from the baseplate into the lower arm motor.

3.2.5 Other Issues

Other issues may arise. If they do, please reach out to Svenzva support at support@svenzva.com.