

Standard Operating Procedure: Automated Reach-to-Grasp Task (AutoRG)

Software/Firmware Download and Initialization

Portions of this SOP have been adapted from learn.adafruit.com

1. Purpose

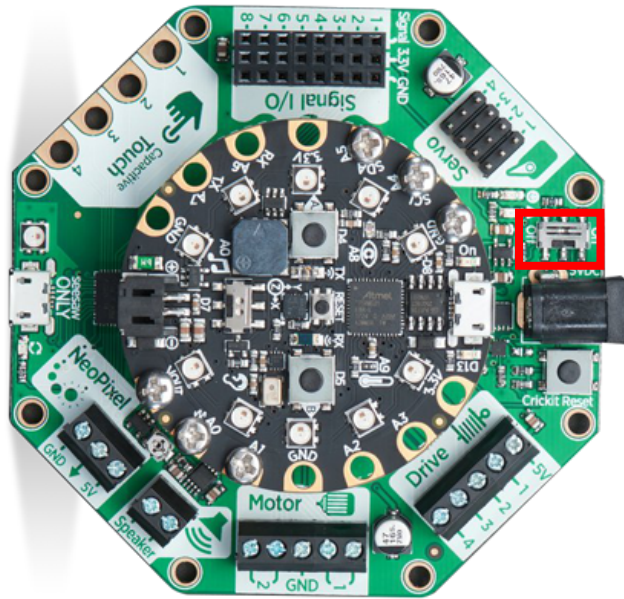
- 1.1. This SOP describes the procedures necessary to properly download and initialize the software (Matlab) and firmware for the AutoRG system.

2. Equipment and Terminology

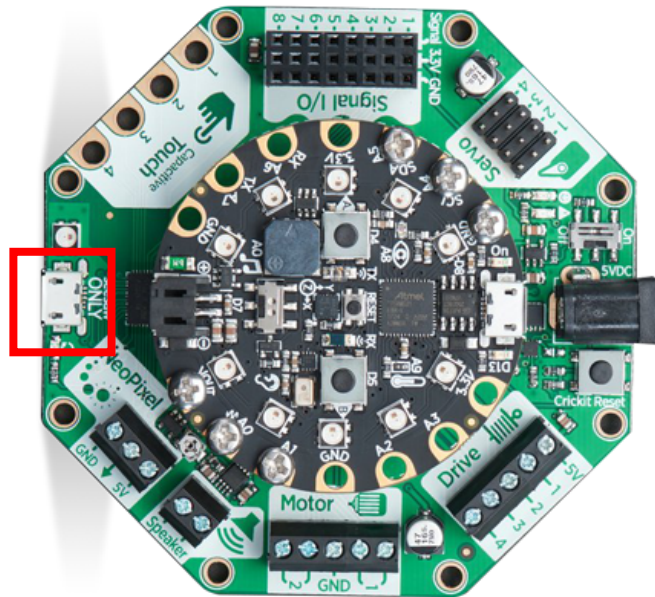
- 2.1. CPX – Refers to the Circuit Playground Express
- 2.2. CRICKIT – Refers to CRICKIT board that is attached to the CPX
- 2.3. Power Cord – Refers to the cord connecting the CRICKIT board to power
- 2.4. USB Cord – Refers to the cord connecting the CPX (micro-USB) to the computer (USB)
- 2.5. GUI1 – Refers to the primary MatLab graphic user interface through which the AutoRG assay is run
- 2.6. GUI1 Code – Refers to the code underlying GUI1
- 2.7. Calibration GUI – Refers to the MatLab graphic user interface that creates the calibration file
- 2.8. Calibration GUI Code – Refers to the code underlying the calibration GUI

3. Download and Initialization Procedure

- 3.1. Download software and firmware files from Github:
 - 3.1.1. FIRMWARE_11.2021_CPX.UF2
 - 3.1.2. FIRMWARE_11.2021_crickit.UF2
 - 3.1.3. GUI1.m and GUI1.fig
 - 3.1.4. GUI_scale_calibration.m and GUI_scale_calibration.fig
- 3.2. Plug Power Cord into CPX/Crickit system (power port is located on Crickit component of system)
- 3.3. Turn Crickit on with switch near power
 - 3.3.1. Green light near switch should appear when switch is on



3.4. Plug data-sync USB cable into “Seesaw ONLY” port on Crickit, and plug other side of USB cord into computer.

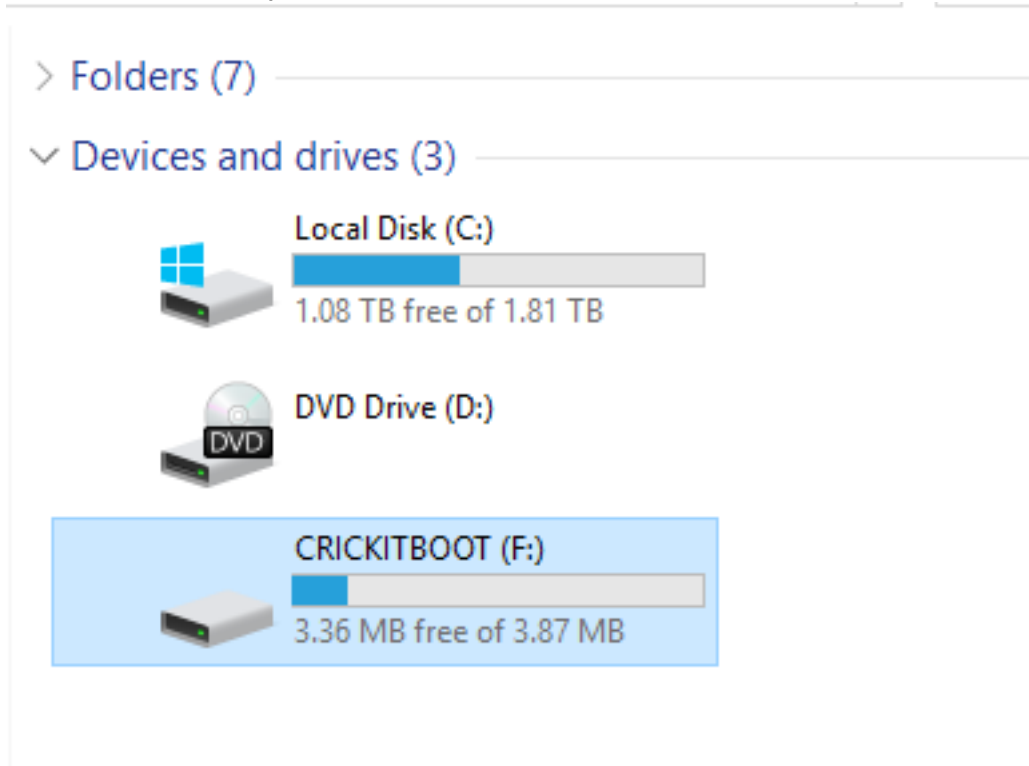


3.5. Double-click the Crickit Reset button

3.5.1. You should see the LED to the left of the button turn green, and the LED to the right of the button turn yellow and start pulsing

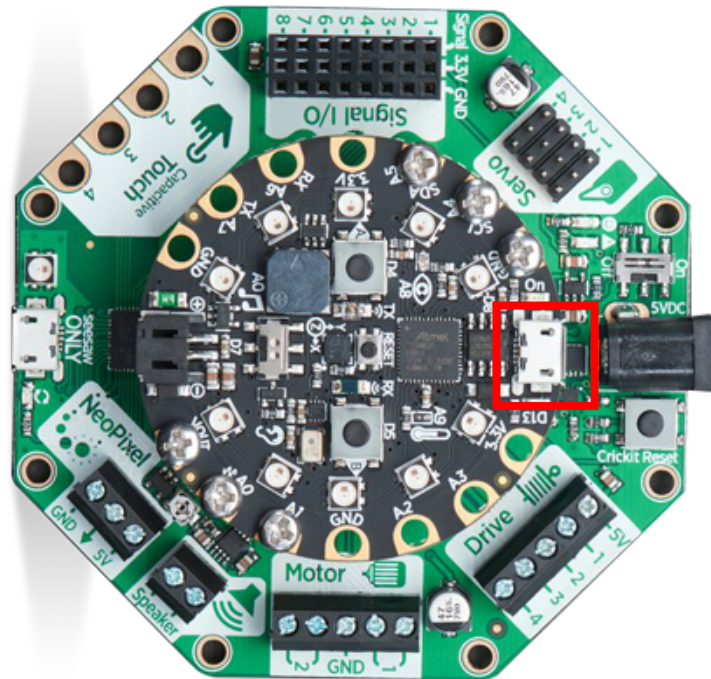


3.6. Find new disk on computer called "CRICKITBOOT"

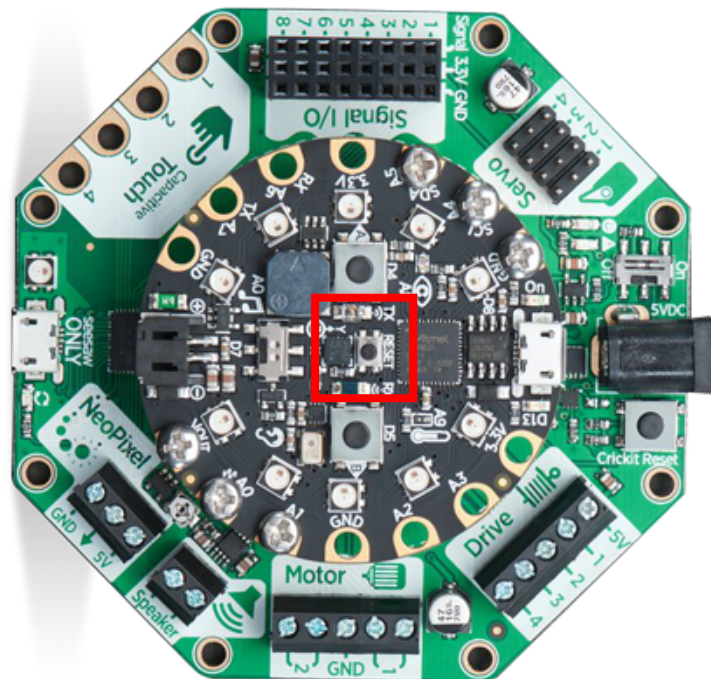


3.7. Drag the file FIRMWARE_11.2021_crickit.UF2 onto CRICKITBOOT

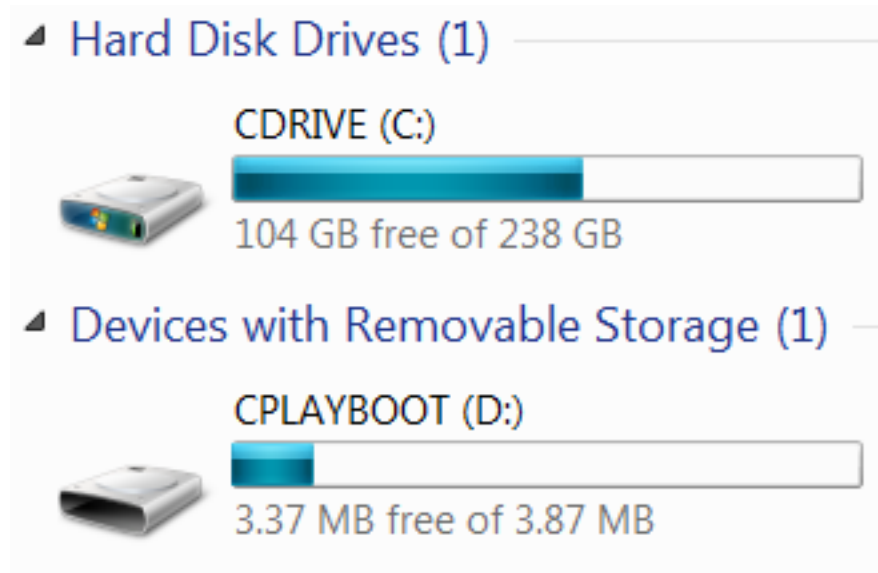
3.8. Unplug data-sync USB cable from “Seesaw ONLY” port. Plug data-sync USB cable into CPX USB port



3.9. Double-click the CPX Reset button in the center of the microcontroller
3.9.1. LEDs should flash red, then turn green



3.10. Find the disk on the computer called “CPLAYBOOT”



3.11. Drag the file FIRMWARE_11.2021_CPX.UF2 onto CPLAYBOOT

3.12. Open GUI1.m

3.13. Use Ctrl + F “ **%EDIT** ” to find all lines marked with an EDIT comment. These lines need to be modified to integrate with user's computer

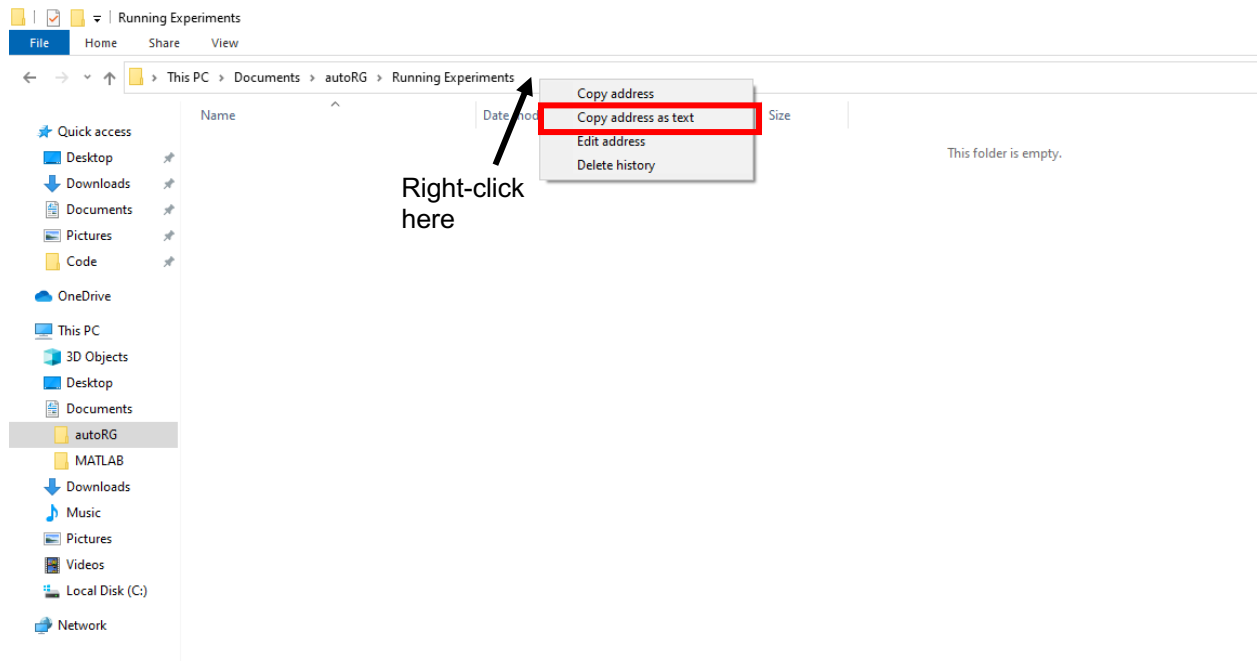
3.13.1. handles.Com : Recommended for user to replace 'COM4' with the COM port on their PC. To find COM port of CPX, ensure USB is plugged into CPX and computer, then navigate to “Device Manager” on PC. Navigate to “Ports”, then find the COM input for the CPX serial connection. *Note: COM number can be inputted directly into GUI but inputting here directly into code allows the convenience of not having to continually re-input the COM number with each training session.*

3.13.2. handles.Animal : Recommended for user to replace this default template with a template that is convenient to the animal identification coding utilized by user's facility/institution. *Note: Animal ID can be inputted directly into GUI but inputting here directly allows the convenience of having to change only a few digits while training many animals.*

3.13.3. handles.ExpName : Recommended for user to replace initials with experimenter identification that is convenient for user. *Can be inputted directly into GUI as well, but inputs directly into GUI will be erased when GUI is closed.*

3.13.4. handles.Assay : If using the default 7-stage training protocol, no action must be taken here. If implementing custom training protocol: Add or substitute name of custom protocol in the same format (separated from other lines by semicolon (;), name inputted as a string (e.g. 'PROTOCOL NAME').

- 3.13.5. handles.Duration : If desired to change default duration of training session, alter the number inside the quotations to the desired number of minutes. Default session duration is 20 minutes, after which the session will end, and the data will be saved to pre-specified PC location. *Duration can be modified directly on GUI, though it will be erased each time the GUI is closed and reopened.*
- 3.13.6. handles.MaxSuccess : If desired to change default maximum number of successes for a training session, alter the number to the desired number of successes. Default max number of successes is 100, after which the session will end, and the data will be saved to pre-specified PC location. *Maximum successes can be modified directly on GUI, though it will be erased each time the GUI is closed and reopened.*
- 3.13.7. handles.Threshold : If desired to change the minimum threshold to initiate a trial, alter the number to the desired minimum threshold (in grams). Default initiation threshold is 10g.
- 3.13.8. handles.savename : Default save name is set to "ANIMALID_EXPERIMENTERID_ASSAYNAME_DATE". Remove or add variables to customize this save name.
- 3.13.9. lowthr : Change this number to match the value inputted for handles.Threshold
- 3.13.10. maxtime : If desired to change the trial time, alter the number to the desired trial duration in seconds. Default trial time is 2 seconds.
- 3.13.11. Save Locations: Wherever "**%EDIT save location**" is found, input the desired save location for the output .mat files. To find this location name:
- 3.13.11.1. Navigate to the folder using the file window on user's PC.
 - 3.13.11.2. Right-click on the address bar at the top and click "Copy address as text".
 - 3.13.11.3. Delete the save location address beginning with C:\
 - 3.13.11.4. Paste the copied address within the quotations
 - 3.13.11.5. Repeat this process for every line denoted by "**%EDIT save location**" : Delete old save location within the quotations and paste the new copied address in its place. As of November 2021, there should be 12 lines that must be updated with the user's save location.



3.13.12. Only use this section if custom protocol is added. Otherwise, disregard this section. For custom protocol is lines denoted by “%EDIT if custom protocol added”:

3.13.12.1. Around Line 437 (as of 11/2021): “switch handles.AssayIdx” section: Add “case” followed by number corresponding to the location of the name of the custom protocol for handles.Assay (e.g., if custom protocol name ‘CUSTOM’ is added after ‘Stage 7 – Assessment’, such as [...; ‘Stage 7 – Assessment’ ; ‘CUSTOM’], then “case 8” should be added to this section). Below, input the distance (in inches) of the handle relative to the inner wall or the variable corresponding to the distance if adaptive distance used. *Distance inputted here is displayed in output trialdata matrix.*

```
case 8
    dist = ____ ;
```

3.13.12.2. Around Line 588 (as of 11/2021): “switch selectedString” section: Add “case” followed by the string used for handles.Assay (e.g., if custom protocol name ‘CUSTOM’ is added then “case ‘CUSTOM’ ” should be added to this section). Below, input “stage = “ followed by some identification number (e.g., 8) or alternative ID. *Stage/Protocol ID inputted here is displayed in output summary matrix.*

```
case ‘CUSTOM’
    stage = 8 ;
```

3.13.12.3. Around Line 737 (as of 11/2021): “ `switch` selectedString “ section: Add “case“ followed by the string used for handles.Assay (e.g., if custom protocol name ‘CUSTOM’ is added then “`case ‘CUSTOM’` ” should be added to this section). Below, input “ handles.AssayIdx = “ followed by the next available number.

3.13.12.3.1. If custom protocol name ‘CUSTOM’ is added after ‘Stage 7 – Assessment’, such as [...; ‘Stage 7 – Assessment’ ; ‘CUSTOM’], then use “handles.AssayIdx = 8”

```
case ‘CUSTOM’  
    handles.AssayIdx = 8 ;
```

3.13.12.3.2. If default stages removed for handles.Assay in step 3.13.4, then begin the numbering at 2 and continue from that number. *Beginning numbering at 2 bypasses several lines that check if the system is past Stage 1. However, if user is not using default 7-stage protocol, these check points are irrelevant.*

```
case ‘CUSTOM 1’  
    handles.AssayIdx = 2 ;
```

```
case ‘CUSTOM 2’  
    handles.AssayIdx = 3 ;
```

... and so on

3.13.12.4. Around Line 830 (as of 11/2021): Copy and paste section from 3.13.12.2 (around Line 737) to replace this section, from “ `switch` “ to corresponding “`end`” .

3.13.13. Reset Function, below comment “%Re-initialize all text and variables”: Copy the initialization sections between the “%AUTORG INITIALIZATION ONLY” markings, which includes all lines between “%Control Variables” near Line 36 to “ guidata(hObject, handles); “ near Line 105. Highlight the lines between “ %BEGIN PASTE HERE ” and “ %END PASTE HERE ” and paste the copied lines in its place.

3.13.14. edit_Threshold : If default trial initiation threshold threshold changed (see steps 3.13.7 and 3.13.9), then alter the text here to match the customized threshold

End of GUI1 Initialization

3.14. Open GUI_scale_calibration.m

3.15. Use Ctrl + F “ %EDIT ” to find all lines marked with an EDIT comment. These lines need to be modified to integrate with user's computer

3.15.1. handles.COM : Update COM as in step 3.13.1

3.16. If custom protocol implemented: “inside”, “onwall”, “outside”, and “assessment” variables. These values are only relevant when using one of default 7 stages.

The following steps are only relevant if custom protocol added

3.17. If adding custom protocol: Open update_param.m function

3.18. Add “case” followed by the AssayID corresponding to the handles.AssayIdx variable created for the custom protocol in GUI1 (see step 3.13.12.3).

3.19. Insert custom algorithm that updates the handle position, trigger threshold, trial time, etc. utilizing inputs from GUI1