**Step By Step Building Guide**

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| **Example Pupillometry Setup** |
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| **Labeled Pupillometry Setup** |
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| **Arduino Protective Cover** |
| **A black box with wires on a black surface  Description automatically generated** |

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| **Assemble the Breadboard** | |
| **Single Breadboard Option** | **Modular Breadboard Option** |
| A black dot board with many colored dots  Description automatically generated |  |

**Assemble the Breadboard (Single Breadboard Option)**

1. Mount post holders according to the above figure
2. Handle - Two SH4S038 screws at coordinates (1,4) and (1,10)
3. Wheel - Two PH3 post holders at coordinates (6,2) and (6,8)
4. Rotary encoder - One PH2 post holder at coordinate (5,11)
5. Head plate - Two PH3 post holder at coordinates (7,1) and (7,12)
6. IR Camera - One PH3 post holder at coordinate (8,9)
7. IR LED - One PH6 post holder at coordinate (10,8)
8. Handle - Two SH4S038 screws at coordinates (18,4) and (18,10)

**Assemble the Breadboard (Singular and Modular Breadboard Option)**

1. Mount post holders according to the singular breadboard option above
   1. Handle - Two SH4S038 screws at coordinates (1,4) and (1,10)
   2. Wheel - Two PH3 post holders at coordinates (6,2) and (6,8)
   3. Rotary encoder - One PH2 post holder at coordinate (5,11)
   4. Head plate - Two PH3 post holder at coordinates (7,1) and (7,12)
   5. IR Camera - One PH3 post holder at coordinate (8,9)
   6. IR LED - One PH6 post holder at coordinate (10,8)
   7. Handle - Two SH4S038 screws at coordinates (18,4) and (18,10)
2. Mount post holders according to the modular breadboard option above
   1. 10 x 8 Optical Board
      * Handle - Two SH4S038 screws at coordinates (1,3) and (1,9)
      * Wheel - Two PH3 post holders at coordinates (6,1) and (6,7)
      * Rotary encoder - One PH2 post holder at coordinate (5,10)
   2. 18 x 12 Optical Board
      * Head plate - Two PH3 post holder at coordinates (7,1) and (7,12)
      * IR Camera - One PH3 post holder at coordinate (8,9)
      * IR LED - One PH6 post holder at coordinate (10,8)
      * Handle - Two SH4S038 screws at coordinates (18,4) and (18,10)

**Step 1:**

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| **Aerial View** | **Angled View** |
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**Step 2:**

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| **Aerial View** | **Angled View** |
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**Step 3:**

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| **Aerial View** | **Angled View** |
| **A metal peg board with several metal rods  Description automatically generated with medium confidence** |  |
| **A metal peg board with several metal rods  Description automatically generated with medium confidence** |  |

**Step 4:**

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| **Aerial View** | **Angled View** |
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| **Constructing the Head Plate System** | | |
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| **Constructing the UV LED, IR LED, and GPIO Cables** | | |
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| **Constructing the Red-Light Strips** | | |
| A close-up of several wires  Description automatically generated | A black and red wire on a black surface  Description automatically generated | A tool on a black surface  Description automatically generated |
| A black and green electrical plug  Description automatically generated | A black and red cable with a green connector  Description automatically generated | A metal nail clip with a wire  Description automatically generated |

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| **Constructing the Rotary Encoder** | | |
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| **Removing the Additional Camera Shutter** | | |
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| **Constructing the Pupillometry Wheel** | |
| A close-up of a bicycle wheel  Description automatically generated | |
| A circular metal object with metal rods  Description automatically generated with medium confidence | A close-up of a wheel  Description automatically generated |

**\* Place the 5 mm bearings into the Thorlabs RA180 component. Pass the 5 mm shaft through the mounting hub of the wheel and fit the joined components through the ball bearings.**

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| **Constructing the Pupillometry Wheel** | |
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| **Installing the Pupillometry Wheel** | |
| A close-up of a metal object  Description automatically generated | A close-up of a machine  Description automatically generated |

**\* The 5 mm mounting hub comes with two smalls screws which can be used to secure the entire pupillometry wheel to the shaft. Tightening this component ensures that movement from the wheel is accurately reflected by the rotary encoder. Insert these two screws into the mounting hub before installing the wheel into the pupillometry system to avoid difficulties.**

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| **Constructing the Aerial Camera Setup** | |
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| **Constructing the Pupillometry Printed Circuit Board** | | |
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| **Arduino Compatible Pupillometry Setup PCB** | |
| **A green circuit board with colorful wires  Description automatically generated** | |
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**The Arduino compatible PCB shield was specifically designed for the purpose of interfacing with all the components necessary for head-fixed experiments. These are the capabilities of the board, based on its current configuration:**

**UV / IR LED Terminal Block (1 x 5 Terminal at Arduino Pins 9 through 12)**

* Four 5 Volt ports in for two UV LEDs and two IR LEDs (With 4 accompanying transistors and resistors)
* One GND port for all four LEDs

**Camera/DAQ/Opto Terminal Block (1 x 6 Terminal at Arduino Pins 4 through 7)**

* Four trigger ports for two FLIR cameras and two monochrome cameras
* One port for the DAQ and Optogenetic Interference Module
* One GND port for all four cameras, the DAQ, and the Optogenetic interference system

**Real Time Clock Terminal Block (1 x 4 Terminal at Arduino Pins D20 SDA and D21 SLA)**

* Two input ports for the single RTC
* One PWR for the single RTC
* One GND port for the single RTC

**Rotary Encoder #1 Terminal Block (1 x 4 Terminal at Arduino Pins 2 and 3)**

* Two output ports for the single rotary encoder
* One PWR for the single rotary encoder
* One GND port for the single rotary encoder

**Rotary Encoder #2 Terminal Block (1 x 4 Terminal at Arduino Pins 18 and 19)**

* Two output ports for the single rotary encoder
* One PWR port for the single rotary encoder
* One GND port for the single rotary encoder

**Other Digital Pins (1 x 4 Termina Block at Arduino Pins x through x)**

* Four digital output pins that can be assigned to any additional electrical systems

**Fail safe LEDs (6 LEDs at Arduino Pins 42 through 52)**

* Six digital output pins that can be assigned to based on relevant binary events
  + Two LEDs can be assigned when an input signal is sent to the IR LED
  + Two LEDs can be assigned when an output signal has been received from the Rotary Encodes.
  + The remaining LEDs can be assigned to indicate a closed loop for any of the cameras or other systems.