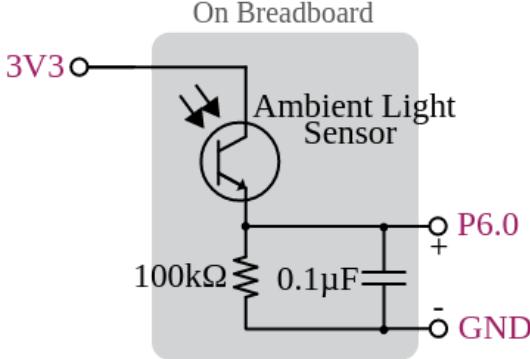
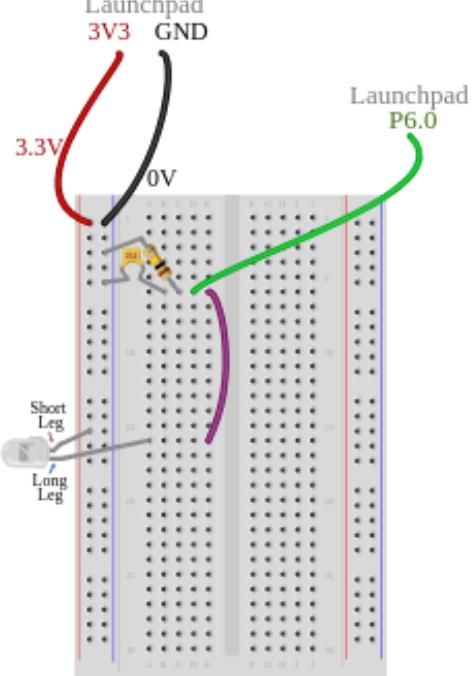


Light Sensor Breadboard Circuit - Cory 140

Build the ambient light sensor circuit on a breadboard and hook it up to the Launchpad, as you did in Imaging Lab 1. This requires the following parts:

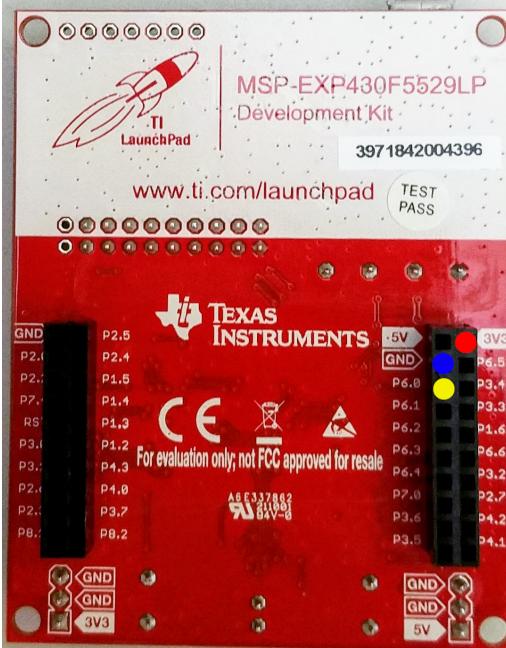
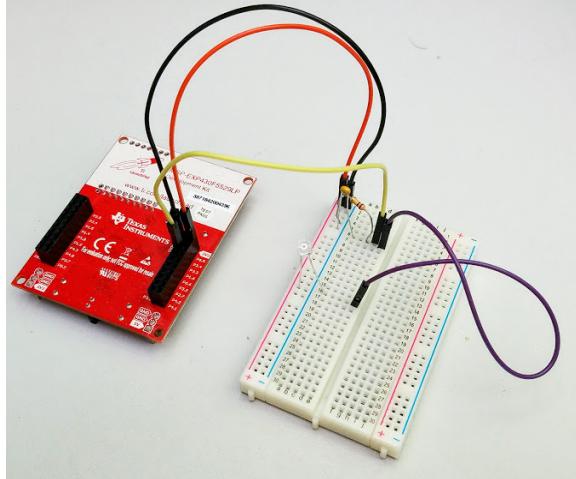
- 1x Breadboard
- 4x Pin-to-Pin Jumper Wires (Exposed metal connections on both ends)
- 1x Ambient Light Sensor a.k.a. Phototransistor
- 1x $0.1\mu\text{F}$ Capacitor (104)
- 1x $100\text{k}\Omega$ Resistor (Brown-Black-Yellow-Gold)
- 1x TI Launchpad MSP430F5529LP
- 1x Micro-USB to USB-A Cable (Long, supplied for this lab in the box)

The schematic that you will build is shown below. Schematic labels in purple indicate connections to the Launchpad. Read through the following instructions to setup your single pixel imager.

Schematic	Breadboard View
 <p>On Breadboard</p>	 <p>Launchpad 3V3 GND</p> <p>3.3V</p> <p>0V</p> <p>Launchpad P6.0</p> <p>Short Leg</p> <p>Long Leg</p>

Setting up the Breadboard:

- Plug the **long leg** of the ambient light sensor into **Row 16, Column A** of the breadboard, as illustrated in the breadboard diagram above. The short leg should be plugged into the nearest hole in the **red (+) column** of the breadboard. Recall that the short leg is the positive end.
- Plug one leg of the **100kΩ resistor** into a hole in **Row 6** of the breadboard. Plug its other leg into a nearby hole in the **blue (-) column**.
- In a similar fashion, plug the **0.1μF capacitor** into a hole in **Row 6** of the breadboard. The other leg should also be plugged into the **blue (-) column**. *Warning: Make sure that none of the legs are touching each other to prevent shorting!*
- Use a **pin-to-pin jumper wire** to connect **Row 16, Column E** to **Row 6, Column E**.
- The Launchpad supplies 3.3V to our circuit. Use a **pin-to-pin jumper wire** to connect the top-most hole (~Row 1) in the **red (+) column** (3.3V supply) to **3V3 on the back of the Launchpad (red)**.
- Use a **pin-to-pin jumper wire** to connect the top-most hole in the **blue (-) column** (0V) to **GND on the back of the Launchpad (blue)**.
- Use a **pin-to-pin jumper wire** to connect **Row 6** (sensor circuit output) to **P6.0 on the back of the Launchpad (yellow)**. The Launchpad can read analog voltage values from our circuit, convert them into digital values, and then send them over to our computer.

MSP	Full Circuit
	

Stand Setup



- Take the wood stand (with projector) out of the cardboard box at your station (located at the top left next to some of the lab equipment).
- Place the breadboard into the vertical slot in front of the projector and the MSP in the flat area on the bottom. You should be inserting the half of the breadboard without the components into the slot so you do not mess up the circuit. Make sure the light sensor is centered at the top, as in the picture above. Try your best to ensure that the jumper wires do not obstruct the projection from the projector onto the index card.
- Place something under the projector to have it sit higher. This could be a phone, second breadboard, or anything else that props up the projector.
- Place the setup into the box - **Pay close attention to where the holes are in the box, picture on next page.** The holes are cut out to make connecting the mini-HDMI and power cables easier. Align the holes to both the circular power connector and the mini-HDMI port on the back of the projector to the short, back side of the box that has a hole in it.
- Route the power cable through the back to the DC connector and the mini-HDMI cable (at your lab station behind the keyboard under the monitor stand, one end already connected to your lab computer) through the back and connect them both to the projector **very gently.** Please ensure you're using the right projector ports.

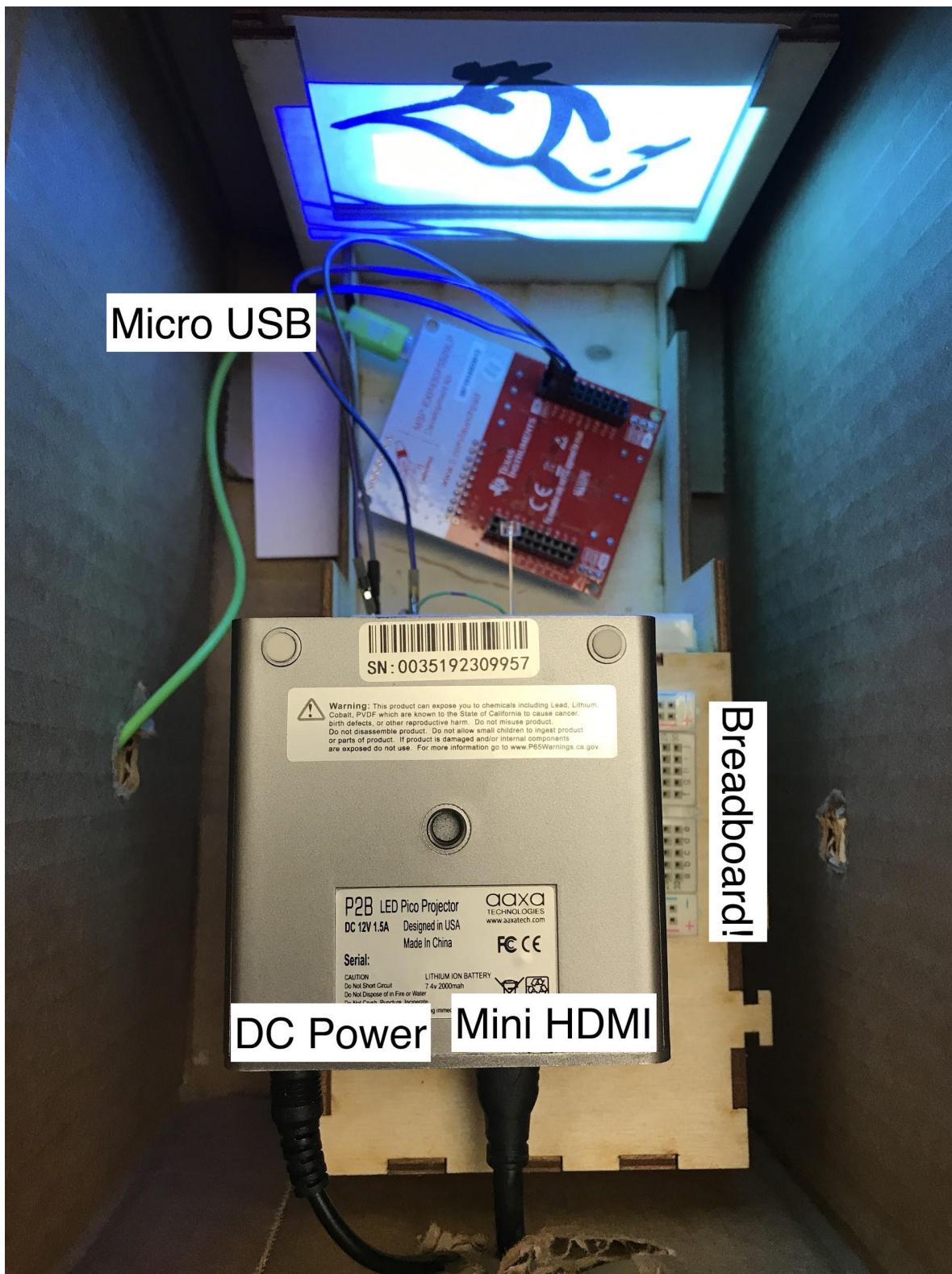


- Take the long USB cable and route it through the side hole (or back) and connect it to the MSP.
- The power cable must be plugged into an outlet - there are outlets at each station (see picture).

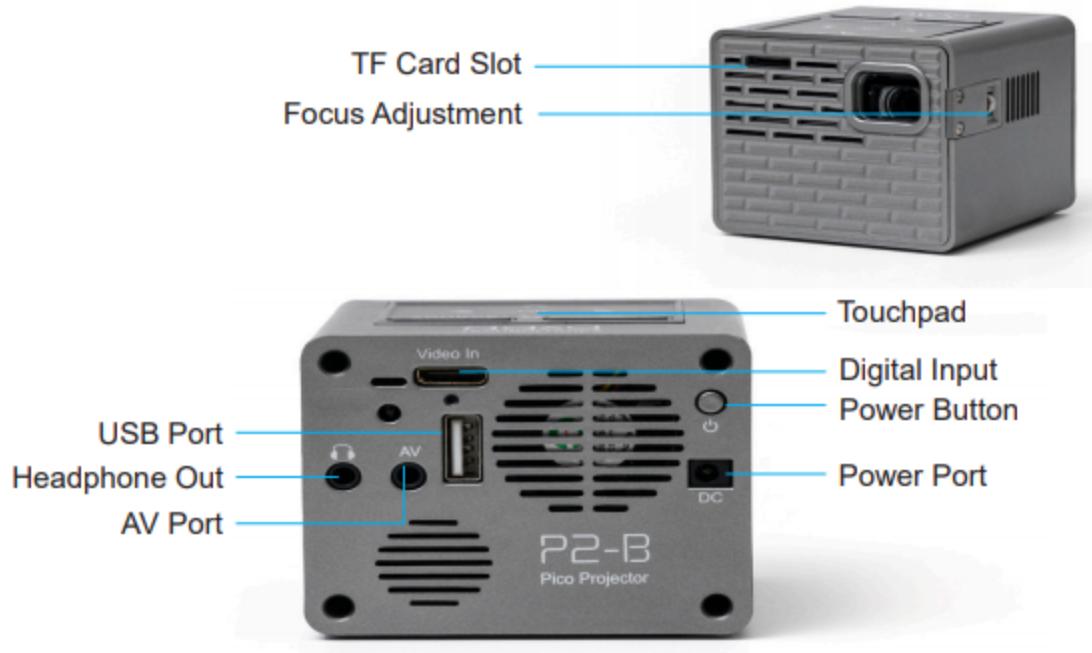


Make sure the barrel connector is fully plugged into your projector - if the connection is loose during the scan you may have issues. **A red light should show on the back of the projector to indicate that it is charging.** Turn on the projector by pressing and holding the power button on the back. **We will be placing the projector upside down**, but not before confirming the projector settings in the next section.

- Plug the USB 2.0 end of the USB cable into the lab computer.
- Confirm your setup with the full setup below



Projector Setup

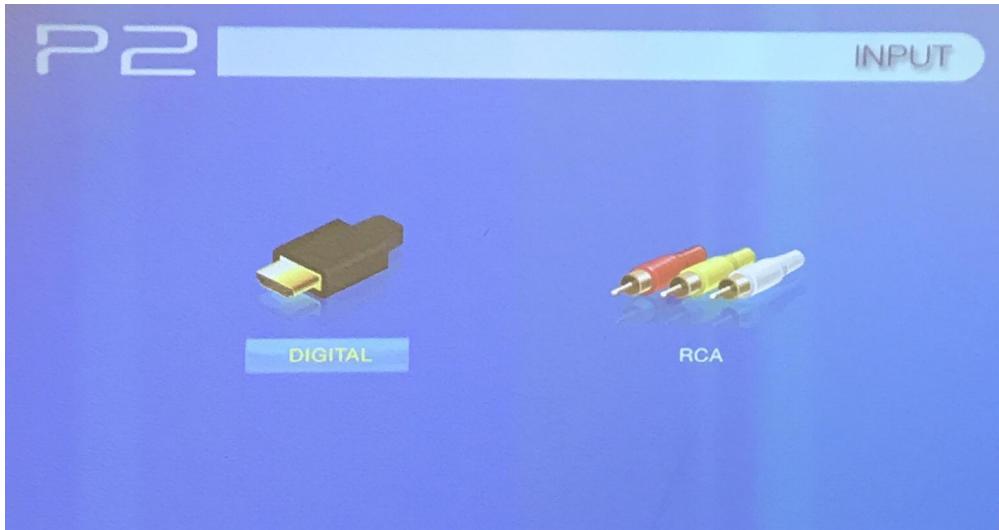


Setup the projector with the following steps:

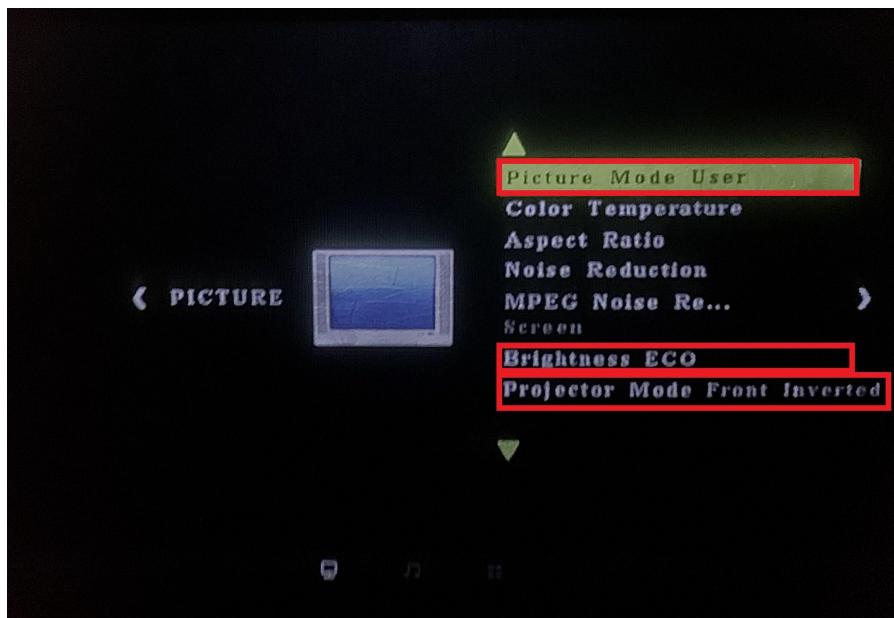
- Turn on the projector by holding down the Power button (see the previous figure). You should see a green light turn on when it powers on.
- Find the Focus Adjustment wheel on the side of the projector to adjust the focus of the projection onto the box. Focus it as close as possible.



- Using the left/right arrows on the Directional Pads, select **INPUTS** on the projector's main menu, then **DIGITAL**. After a few seconds, you should see the Windows 10 desktop.



- If you see the Windows 10 taskbar at the bottom of the projected screen, take the following precautions:
 - Hit the **Windows** key and type **Settings**.
 - Click on the **Personalization** icon.
 - Click on **Taskbar** on the left side.
 - Under the **Multiple Displays** section, turn **Show taskbar on all displays off**.
- Use the **Back button** on the projector to return to displaying the **main menu**.
- Use the left/right arrows to select the **Settings** option (gears icon, see picture on previous page).



- Select **Picture Mode** and change the **Picture Mode** from Standard to **User**.
IMPORTANT: Use the down arrow to move the cursor down to **Contrast**. Then use the right arrow to adjust the contrast to **100**.
- **IMPORTANT:** Move the cursor down to **Brightness** and use the left arrow to adjust the brightness to **0**.
- To **Confirm the Selection**, hit **OK** and exit the menu with the **Back button**.
- Go back to **Settings** and select **ECO** for **brightness**
- Hit the button **SOURCE** and then **DIGITAL** and make sure that you see the Windows 10 desktop on your projector.
- Place the properly set up projector **upside down** on top of something to prop it up (e.g., a second breadboard, a phone, etc.) on the stand. If you do not have anything to prop up the projector, proceed as usual, though you should note that you may not be able to take a full picture.

Launchpad (MSP430) Setup

- Launch Energia (from Desktop)
- Open the AnalogReadSerial program in Energia (File > Open). This is a different Launchpad code from last week, and can be found in the Imaging Lab 2 or 3 folder you downloaded. Select the right Serial Port (Tools > Port) by going to “Device Manager” and finding the MSP UART port. Upload the code by clicking on the Upload button (white circle with a right-pointing arrow, as shown below):



- Hit the RESET button on your MSP (labeled RST).
- To verify that the program is working, type a 6 into the serial monitor (accessed in Energia via Tools > Serial Monitor). You will need to set the Baud Rate to 115200. You should see a reading from the ambient light sensor appear. If the numbers increase with light and decrease with less light your setup is good. You must close this window before continuing.

