3D Camera Lesson Plan

Amount of time Demo takes: 3-5 mins.
Try this at home!

Materials
● Minoru 3D Webcam
● Lap top that is set up to work with webcam (Driver on Minoru website is available for download, computer needs to be **restarted before using**.)
● Monitor to set up with laptop
● Red/cyan glasses
● Fun props for the person recording to use, pom pom, foam finger...?
● 3D images either printed or on thumb drive to show to participants (currently not included with kit)
● **Needs electricity!**

Set-up Instructions
(If you would like to put some 3D images on a memory stick to show people that would be a great way to add to the lesson.)

1. Computer with correct driver and updates for camera needs to be set up **before event**, computer will need to be restarted after installing driver for the camera to work.
2. Install a special driver which makes the computer properly communicate with the webcams (install this one first). This is a compressed zip file. After you uncompress it, run the executable file:
3. Then install the software that demos the webcam:
   [http://www.voipvoice.com/downloads/Minoru/Minoru_update_3_0_4_1.exe](http://www.voipvoice.com/downloads/Minoru/Minoru_update_3_0_4_1.exe)
4. Once it is installed, there will be an icon near the clock in Windows which will allow you to change the settings.
5. The files above are the newest ones available as of Aug 2011. You can check the website for the webcam for updated versions:
6. Plug camera in with a USB cable.
7. Attach a second monitor to the laptop so it is easier to view for participants. Set the monitor at a level so the 3D video looks good to a participant standing and looking at it. It may need to be elevated.

8. The camera will need you to adjust the image. As long as the camera is level and the red/cyan appears level you should be able to leave the vertical adjustment alone. The red/cyan adjustment will need to be adjusted; there is a button on the lower left panel that will let you drag a bar back and forth to set where the red/cyan images fall. After some testing it was most comfortable for my eyes with the bar at about 25% on the left.

9. Set out a few pairs of 3D glasses. Make sure participants give them back!

SAFETY!
- When setting up computer, monitor, and camera make sure they are secure. The table or whatever they are placed on will get bumped and probably touched by participants.
- Remind participants to be gentle with equipment, 3D glasses, computer, monitor, and camera
- If people feel like they are starting to get a headache or if they feel eye strain, they should stop using the 3D glasses.
- Avoid changing the camera settings when people are looking at the screen.

Lesson’s Big Idea
- How do we make an image 3D and what is this image called? Use two images that can be converged into a single image to create a stereoscopic view of a picture creates an image that appears to stand out. This is called a stereoscopic image. They can be viewed with red and cyan glasses or polarized glasses to have the left and right eyes see different images.
- By using red and cyan glasses the colors allow only those light waves to pass to your eye creating a separate image for each eye that your brain then combines into a single image.

Background Information
- 3D images are when we see two different images in our left and right eyes. One way to make a single computer screen show a 3D image is to draw two different images on the screen using different colors, creating an “anaglyph” image.
• The most common form of anaglyph images use a red film in front of the left eye (only red light to pass) and a cyan film for the right eye (blue and green light to pass).
• Three visual cues for depth perception important for viewing anaglyph images:
  • Convergence: When focusing on something, both of eyes will point at the object focused on. If you focus on a point at the horizon, your eyes will point parallel to each other. However, if you try to focus on your nose, your eyes will both point inwards towards your nose. The way that your eyes are pointed can provide your perceptual system with information about the distance to the point focused on.
  • Accommodation: When focused on an object, the lens in eyes adjusts so the object appears sharp. If you hold your hand in front of yourself and focus on it, objects behind and in front of your hand will appear blurry. When you are viewing an anaglyph image on a screen, accommodation will always indicate that the depth to any point in the image matches the distance to the screen. Accommodation is a cue for depth that conflicts with the depth information that we are trying to display!
  • Binocular disparity: When both of your eyes are focused on one particular object, the point that you are focusing on will fall onto your retina in the exact same place in each eye. However, when another object at a different depth from the object you are focusing on will appear at slightly different locations on your two retinas. This disparity can inform our perceptual system that other objects in the scene are in front of or behind the object that our eyes are focusing on.
• In the real world, convergence and accommodation are never in conflict. Viewing any synthetic 3D image, accommodation will always indicate that the entire image is at the depth of the screen, but convergence will indicate that objects are at different depths. This conflict is one of the reasons some people feel eyestrain or get a headache.
• Polarized lenses are used in theaters’ 3D projections. Two projectors project different images onto a screen through polarizing lens. Then, the viewers also wear lenses so that only the left eye sees the left image and the right eye sees the right image. There are two different types of polarization that can be used linear polarization (commonly used in sunglasses) and circular polarization. In linear polarization, light waves
which move in a up-down fashion are allowed through one of the filters and light waves which move in a left-right fashion are allowed through another filter. Circular polarization uses the clockwise or counter-clockwise nature of the light waves to distinguish between the left and right images.

- **Anaglyph images:** When an object is displayed “behind” the screen, we display the object at two different locations. The object visible to the left eye (red) is displayed to the left of where the same object appears for the right eye (cyan).

![Diagram of anaglyph images](image1)

- When we want to display an image as being “on” the screen, the object is at the same location for the left and right eye. In the image, the foreground appears at the depth of the screen and the background appears behind the scene. Without glasses, you can see the cyan imagery appearing to the right of the red imagery in the background. Furthermore, the foreground of the image looks like a normal photograph without glasses because the left and right eye images are aligned.

![Diagram of image on screen](image2)

- When we want to display an image as “in front of” the screen, the object is at two different locations on the screen. The object visible to the left eye (red) is displayed to the right of where the same object appears for the right eye (cyan).

![Diagram of image in front of screen](image3)

- The second image is similar, but the red image has been shifted to the right until the left and right images were aligned in the background. So the background appears at the depth of the screen and the foreground appearing in the front.

- One “problem” with this image, is that the object in the foreground is cropped by the edge of the image which appears at the depth of the
screen (because both the left and right image are cropped at the same location on the screen). This makes the 3D effect less strong near the lower left corner of the image. In the first, the background appears behind the frame of the image. We see this effect in real life whenever we look through a window where a distant scene is being occluded by a closer window.

Historical pictures: Here are pictures of the mining industry taken around 1916. The individual left and right images of these stereo photographs are available on the Library of Congress website.

- Miners in car entering slope shaft which is 5,000 feet deep, Calumet-Hecla Mines, Calumet, Mich.

Assessment /sample questions you can ask
1. What is an anaglyph image?
2. Why does having one lens red and the other cyan allow us to see an image in 3D?

Clean Up
- Clean up between demos if needed. When completely finished gather all materials listed for this demo and make sure everything is accounted for. If
something was used up, broken, or damaged. Let someone know so it can get replaced or fixed.

- Pack up camera into box and pack up monitor and laptop so they are not damaged in transit.

**References**
- Scott Kuhl Ph.D. Computer Science, Human Perception MTU
  - [http://www.cs.mtu.edu/~kuhl](http://www.cs.mtu.edu/~kuhl)
- Computer Science, Human Perception Author: Scott Kuhl
  - [http://www.cs.mtu.edu/~kuhl](http://www.cs.mtu.edu/~kuhl)

**Next Generation Science Standards**
- K-5
  - 1-PS4-3
  - 4-PS4-2
- 6-8
  - MS-PS4-2
- 9-12
  - HS-PS4-5