Ancillary Equipment Operation

This document describes how to use the ancillary in the Center for Cognitive and Behavioral Brain Imaging at the Ohio State University. We will briefly describe some design ideas, but mostly focus on how to operate the equipment, and the precautions you need to take.

The ancillary equipment includes those devices used to deliver visual stimulus and auditory stimulus, collect subject response, record speech, and track eye movement. Figure 1 shows the data flow among different devices.

The idea is to control all the devices by one of the stimulus computers. The KVM switch is connected to stimulus computers on the left side of Figure 1, and is used to switch to one of the computers into the system. The hollow arrows from computers indicate multiple-cable connections, including audio, microphone, USB, and DVI. All other ancillary devices, except the VGA video path, are connected directly or indirectly to the KVM. We will discuss each piece of equipment later. Although Figure 1 looks complicated, the usage of the system is actually simple.
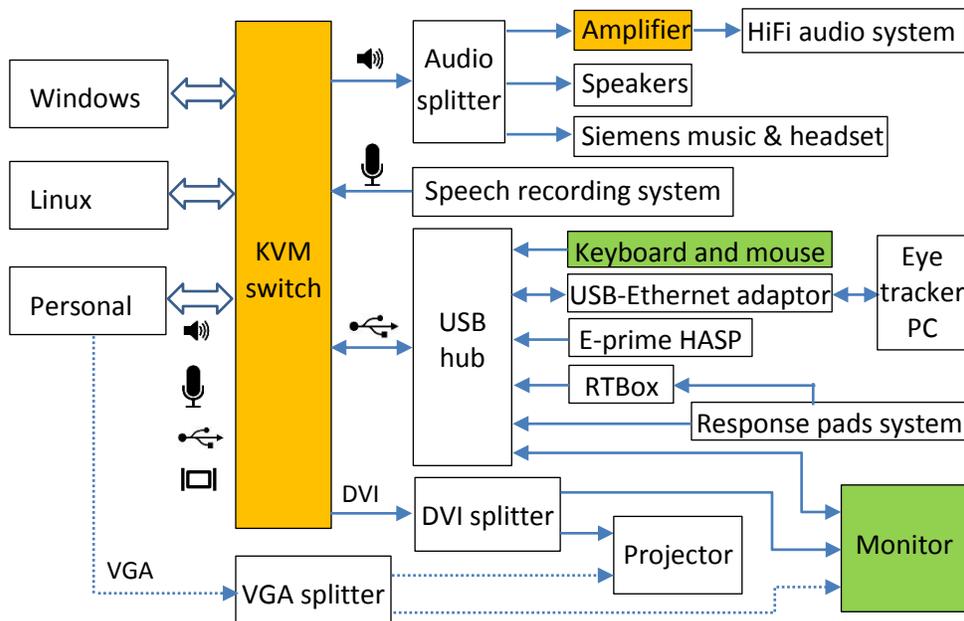

Figure 1. The diagram for signal flow among different devices. The idea of the design is to allow different stimulus computers to easily control all the devices. If one of the Center provided computers is used, there is no need to plug or unplug any device. If a personal computer is used to control stimulus, the computer's video, USB, and maybe audio and microphone ports need to be connected to the KVM. The signal in the dashed lines is the analog video signal, which is used only if the personal computer doesn't have digital video output. The speaker is used for experimenter to monitor what the subject hears. The monitor shows what the subject sees. The green boxes indicate the equipment attached to the subject. The orange boxes indicate the equipment an experimenter needs to operate. Note the arrows in the diagram indicate major directions of signal flow.

Stimulus computers

Stimulus computers control the visual display and/or sound to the subject, and collect subject button response. It can also be used to record the subject's speech if needed.

To be flexible for various research projects, the Center provides two stimulus computers, a Windows 7 computer, and a Linux Ubuntu computer. Both computers are installed with common software packages if applicable, including Matlab and E-prime etc.

Some users may choose to use their own computer to run experiments. The advantage is obvious because you have full control of your own computer --- the experimental program can be fully tested, you won't run into any incompatibility issues, and you don't need to copy behavioral data from the stimulus computer. For this purpose, we reserve a KVM port for personal computers, which will be the user's laptop most of time, but can be any computer. If you use E-prime, don't worry about its license key. Once your computer is connected to the KVM switch, you will have access to the license key automatically.

For video output, we suggest you use DVI if possible. Our two stimulus computers use DVI output to drive the projector. If your computer doesn't have a DVI port, but DisplayPort or HDMI, we provide adaptors to convert it into DVI. Some computers may only have a VGA output. The video quality of VGA may not be as good as DVI because there is a long cable between the computer and the projector. Figure 2 shows several common computer video output ports.

DVI	VGA	DisplayPort	HDMI

Figure 2. Common computer video ports. DVI is recommended, although VGA is supported too. DisplayPort is used by some new computers, and HDMI is the popular port for HDTVs. Both DisplayPort and HDMI can be converted into DVI.

If you use your own computer, you will need to connect it to the KVM switch. The cables you need to connect include a video cable (DVI or VGA depending on your video output), a USB cable, a 3.5mm audio output cable (green connector) if you want to play audio from your computer, and a 3.5mm audio cable (pink connector) if you want to record speech during experiment. Figure 3 shows the various connectors. After you connect your computer to the system, the monitor (together with the projector) will be your secondary display. You may need to set the settings for this display to 1280x1024 at 60Hz.

Figure 3. Cable connectors to the personal computer. You will need to connect one of the video ports (DVI or VGA) and the USB cable. If you want to play any sound, you will also need to connector the green connector (🔊) to your audio output port. If you want to record speech to your computer, you will need to connect the pink connector (🎤) to your microphone port. Note that the audio port and microphone port have the same size, so you will need to distinguish them by color or symbols.

To choose the computer for your experiment, simply press down the corresponding switch button on the KVM switch for a couple of seconds until you hear a beep. Figure 4 shows the 4-channel KVM switch.

Figure 4. Four-channel KVM switch. This is the switch to select different stimulus computers. It will switch video, audio output, microphone input and USB to one of the stimulus computers.

The USB port will connect several devices to the computer you switch into, including the keyboard and mouse to control the computer, response pad, RTBox, USB hub on the monitor (e.g., you can plug your memory stick to copy data), E-prime license key, and eye tracker host PC (via a USB to Ethernet adaptor).

In short, if you use your own computer, you will need to connect the needed cables to it. Then the only thing you need to do is the switch the KVM to your computer.

Projector

The projector is one of the most important pieces of equipment for our setup. Figure 5 is a picture of the projector and its remote control. The projector is located behind the magnet room.

Here are some default settings for the projector.

Resolution: 1280x1024

Refresh rate: 60 Hz

Display height: 24 cm

Figure 5. The Christie DS+6K-M DLP projector and its remote control. A special lens is used to generate the smaller image.

Viewing distance: 74 cm

Pixels per degree at the screen center: 55.1

Gamma: 1 (linear)

CIE color coordinates at half-maximum intensity:

Red: x=0.649   y=0.344   Y=57.5

Green: x=0.341   y=0.636   Y=276

Blue: x=0.140   y=0.041   Y=12.2

Gray: x=0.330   y=0.367   Y=521

The projector is calibrated at this setting. You must not change the setting of the projector without discussing it with the Center personnel.

Response collection and scanner TR trigger

We use the fiber optical response pads (fORP) in the magnet. There are two response pads, each with 2 buttons. The default buttons are four numbers, "1", "2", "3", and "4". The TR trigger from the scanner is also connected to the fORP interface, and represented as "5". In other words, if a window, such as NotePad or Matlab window, is open, you will see "1" through "4" when a subject presses one of the buttons, and you will see a "5" whenever there is a TR trigger from the scanner. These buttons can be set to other key names if needed.

The typical way to synchronize the stimulus and MRI acquisition is to use the first TR trigger to start your stimulus presentation. The TR trigger is issued once at the beginning of each TR.

Another option to collect responses is to use the RTBox driver. The RTBox (response time box) is designed to measure accurate response time. In our setup, it receives signals from the fOPR interface, so you can use the same response pads for the subject. The only difference is the command to read the response in your code.

The first time you connect your own computer to the KVM switch, you may see that your computer detects some USB devices, including a USB-to-serial converter, which is for the RTBox. To use it, you need to install its driver. If your computer doesn't have its driver, you can go to http://www.ftdichip.com/Drivers/VCP.htm and download the driver for your computer system. If you use Matlab, you are strongly recommended to use RTBox. Besides the response time accuracy, you won't get those numbers popped into your program window.

In E-prime and other software packages, you can treat the RTBox as a serial response box. Each event, including the TR trigger, is represented by a byte.

In any case, once you connect the USB cable to your computer, you will have access to both the fORP and RTBox. You simply choose the one which best fits your need.

Eye glasses

For those subjects whose glasses are not MRI safe, the Center has MRI safe frame and variable lenses. You are suggested to ask the subject in advance whether he/she wears glasses, and if yes, get their prescription. Always put the lens back to their original slots after you use them.

Auditory stimulus

The audio signal from a stimulus computer can be delivered to the subject either via the Siemens auditory system or our HiFi system. If you use your personal computer, you will need to connect the audio output to the green audio connector (Figure 3).

One of the following three methods can be used to deliver the auditory signal.

(1) For most users, the audio signal from the computer may be simple feedback, such as beep or a simple sound, indicating correct or incorrect responses. For this purpose, the Siemens built-in auditory system should be enough. The sound will be played into the magnet bore or to the headset if you are using 20-channel coil.

(2) If you need better sound quality, the next option is the new MagnaCoil headset which delivers sound into ears through a tiny tube. Special earplugs are needed for this (Figure 6).

Figure 6. MagnaCoil headset and its earplugs.

(3) The last choice is the HiFi system which plays sound into ears through tiny earphone. This is requires special earplugs (Figure 7). To use this system, you need to turn on the amplifier (Figure 8) at the bottom of the equipment rack. The two volume knobs on the amplifier can be used to adjust volume, but you won't do that most of the time. You normally adjust volume on your computer. Please keep in mind to always start from low volume on your computer.

Figure 7. HiFi earphones and the earplugs. Red one is right channel and blue one for left channel (you can remember this by two R's: red for right). The earplugs are screwed on the plastic tubes.

The option (3) gives the best sound quality, but since wires are connected into the magnet bore, and it can introduce noise, although the equipment manufacturer claims the noise is minimal. We recommend to use option (2) if possible.
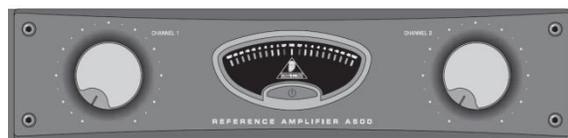

Figure 8. HiFi Audio amplifier. You normally need to only turn it on and off.

Option (3) also need to apply the software equalizer to your wav files. The software works only for Windows and can be downloaded at http://www.sens.com/downloads/. You are advised to collect all your wav files, and do the conversion once.

Speech recording

If you record speech during an experiment, you will use the MRI safe microphone. We use two straps to attach the microphone stand to the coil, and adjust the flex-boom to place the microphone to subject mouth as close as possible (Figure 9). This is very critical for get better speech signal. We have two microphones, and they can be used to do noise cancelling purpose.

Please note that, the microphone is connected to an optic fiber, and you should never pull the fiber too hard. When adjusting the microphone position, always hold the boom to bend, instead of holding the microphone.

Figure 9. Speech recording microphone, the flex-boom and stand to mount it to the subject. The microphone should be as close to the subject's mouth as possible, but without touching subject.

When you switch to one of the stimulus computers you use, the recording will also be switched to the stimulus computer. Most of the time, the stimulus computer can record speech as a background task while presenting stimulus. If this is not the case, you have to use a laptop or another stimulus computer to record speech, and you need an additional connection for this to work. We have a Matlab code to perform the recording in background, and you need to insert only one line into your code where you will like to start recording.

Eye tracker

The Eyelink Eye tracker host PC is a special computer running DOS, which makes the acquisition timing reliable. This may be hard to operate for most users, but users seldom need to operate the host PC directly. The host PC is connected to stimulus computers via Ethernet port. To control the eye tracker through a stimulus computer, you could use the software from SR-research, Psychtoolbox within Matlab, E-prime, or other packages if there is Ethernet control.

The two stimulus computers are set so they can control the eye track PC through your program. If you use your own stimulus computer, for the first time, you have to manually set the extra Ethernet connection (not your built-in Ethernet connection) to the following parameters:

IP address: 100.1.1.? (where ? can be 2, 3, 4 etc)

Subnet mask: 255.255.255.0

Default gateway and other settings: blank.

Normally the eye tracker system is off. If you want to use it, you simply turn on the switch behind the host PC, which will turn on all devices for the system.

The infrared emitter eye camera and its lens are located at the lower portion of the rear projection screen. Occasionally, we may need to adjust the camera focus in case that eye image is not focused well. This may happen when participant head size is very different from others. The best focus is achieved when the cornea reflection is the sharpest.

For command detail to control eye tracker, consult the eye tracker user manual.