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**Augmented Reality Sandbox (ARS)**

**Instructions for Set-Up and Use**

**Materials**

* Optoma Short-Throw Projector
  + Long HDMI cable
  + Black power cable
* Xbox Kinect Camera
  + Power/USB cord splitter (orange input one end, power and USB cord other end)
* Laptop computer
  + Power cord
  + Mouse
* Black power strip
* Orange Extension Cord
* 4 buckets of sand (~150 lbs)
* 1 Bucket of supplies
  + Red brush
  + Red dustpan
  + Folgers can with extra small supplies (projector remote, projector lens cover, extra Velcro straps, calibration tool, allen wrench)
* Computer bag (holds computer, projector, Kinect)
* Metal cart
* Sandbox
* Detachable arm (holds projector/camera)
* Binder

***Helpful Hints***

* If there are any problems with the program, just *exit the terminal application and then restart the ARS* *program*. Restarting the computer/projector is probably not necessary. (Troubleshooting instructions below.)
* *Wi-fi does not have to be enabled*, it’s better if it isn’t. The ARS is a stand-alone device.
* If you are leaving it running at a multiple day event, turning off the projector and extra screen at night is the only shut-down needed. The computer can continue to run the program for a long time if there are no issues.
* Please protect the computer and projector…*with your life*. We want as many people as possible to enjoy it.

**Set-Up Instructions**

***Helpful Hint*** *If you’ve tried everything or are having a weird problem (it happens), text or call Hillarie (517) 983-8436 or Rachel (734) 674-8909.*

1. If using a skirt, put it on before the wooden box. Insert the detachable arm onto the back side of the sandbox lined up with the markings on the edge of the wooden box. Use velcro straps to secure the arm near the floor.
2. Place the Kinect camera at the end of the detachable arm and position it using the black screws as guides. Don’t worry about the placement of the cords yet.
3. Attach the projector to a detachable arm using the empty bolts and wingnuts provided but do not tighten all the way because you will need to adjust it later.
4. Connect the HDMI cable and power cable to the projector.
5. Slide the arm up to the position marked (lined up with the bottom bracket on the arm). Position the projector so it’s aligned with the mark. Tighten the wingnuts on the projector so the projector is secure. You may have to adjust the height of the projector for calibration once the image appears. The image should fill the box and not overflow much, if at all.
6. Plug the projector, Kinect power cord, and computer power cord into the power strip. Position the Kinect camera cord so that it hangs down the back of the detachable arm.
7. Plug the computer power cord, HDMI cable, and Kinect USB cord into the computer.
8. Plug the power strip into power. Strap powerstrip to arm under box with holes facing in to avoid sand getting in. Turn on the projector. Once it boots up, select HDMI on the remote. (Kinect camera will automatically turn on with the computer). Do not turn on the computer until the projector is fully booted and projecting.
9. Slide the cart into place and lock wheels.
10. Pour sand into the sandbox.

**Run the ARS Software**

1. Turn on and log in to computer

Password: H2Oislife!

1. Open “RunSandbox.sh” application by double-clicking the icon on the desktop. Click “Run”
2. Click F11 for full screen if the program did not run in full screen automatically.
3. To create heavy rain push 1 and to ‘drain’ the box press 2
4. Tuck everything safely under the cart and cover the computer with a box to protect it from sand.
5. To shut down, close the computer and press “power” on the projector remote twice.

**Simple Calibration**

Every time the ARS is assembled, the calibration will be off.

1. Start by making a mountain with a white snow top. Observe how the color being projected lines up with the actual sand hill. The goal is to get them as close as possible.
2. Adjust the projector first. Make sure the projector is filling the box as closely as possible and the image isn’t “spilling” over the edge.
   1. If the image is too big, gently lower the projector.
   2. If the image is outside of the box on one side but not filling the box on the opposite side, you can tilt the projector back and forth, and side to side to get it lined up.
   3. If the image is too small and doesn’t fill the box, gently raise the projector until it does.
3. Once the image projected is lined up how you want it, notice the alignment of the mountaintop again. If it still isn’t lined up, adjust the Kinect Camera.
   1. Without moving any screws, you can start by gently aiming the camera. Be patient because it takes a minute to see how your movements impact the image on the sand. It’s not a mirror image so you will need to move the camera in the opposite direction of where you want to see the image move.
   2. Sometimes (rarely) you may need to move the camera back or forth to align the image. If so, you will need to get on the stool, loosen the screws at the top of the arm that holds the camera and slowly move it until the image placement is where you want it.

***Helpful Hint*** *If you’ve tried everything or are having a weird problem (it happens), text or call Hillarie (517) 983-8436 or Rachel (734) 674-8909.*

**ARS Software Buttons**

1 : rain – make a simulated rainstorm across the whole box

2 : drain – drain water from the sandbox

Click or hold those keys for the function to work. No other buttons do anything special

**Restart the ARS and Troubleshooting**

If the ARS goes to “sleep”, you may see that the projector has turned off or the image on the computer is jumbled.

**If the image on the screen looks good but it isn’t showing up on the sand**,

1. This means the computer isn’t communicating with the projector. Disconnect the projector by pulling the HDMI cable out of the computer and then plug it back in.
2. You may have to push the power button on the projector/remote and choose “HDMI” again.

**If the image on the screen looks jumbled**,

1. You simply need to restart the program.
2. Hit the escape button. The screen will vanish and you will see the desktop with the black terminal window running.
3. Click the x in the corner to close that terminal.
4. Open “RunSandbox.sh” application by double-clicking the icon on the desktop. Click “Run in terminal”.

***Helpful Hint*** *If you’ve tried everything or are having a weird problem (it happens), text or call Hillarie (517) 983-8436 or Rachel (734) 674-8909.*

**Advanced Calibration**

**NOTE:**

**BEFORE STARTING CALIBRATION PROCEDURE CONFIRM PROJECTOR AND KINECT CAMERA ARE PLACED PROPERLY**

1. Make sure the projector and Kinect camera are placed correctly and turned on.
2. Retrieve calibration tool (cd with crosshairs taped to cylinder).
3. Open Terminal application and *type the following exactly:*

cd ~/src/SARndbox-2.3

./bin/CalibrateProjector –s 1920 1080

1. Move sand around so that there are high and low spots.
2. Make sure nothing is in or around the sandbox.
3. Bind M to “Capture” and then select “N”. Projector will switch to a red screen for a few seconds. This captures the background sand surface for calibration. After the red screen clears, there will be a black screen with white crosshairs.
4. Place the calibration tool so that the projected white crosshairs match with the crosshairs drawn on the calibration tool (It’s not important that the hairs themselves line up… just that the center is lined up exactly.)
   1. While placing the calibration tool, be sure to keep it as level as possible.
   2. At this time, take your hand away from the calibration tool. There should be a green circle (circle placement is irrelevant).
5. When you are content with the placement of the calibration tool (crosshairs match, top of tool is level, green circle is projected) take your hands out of the sandbox and press the “M” key. *Keep your hands/other objects out of the box until the crosshairs move. It will take approximately 2 seconds.*
6. After the crosshairs move, repeat steps 7 and 8. There will be 12 points that you will calibrate in this way.
7. At the end of the calibration, a red crosshairs will come up and follow the calibration tool as you move it around the sandbox.
8. If you still aren’t happy with the calibration, continue collecting points as in steps 7-9. When the red crosshairs follow the cross on the calibration tool, you’ve successfully calibrated the ARS.
9. Press the escape key to exit the calibration.
10. Run the ARS software.