3D SCANNER

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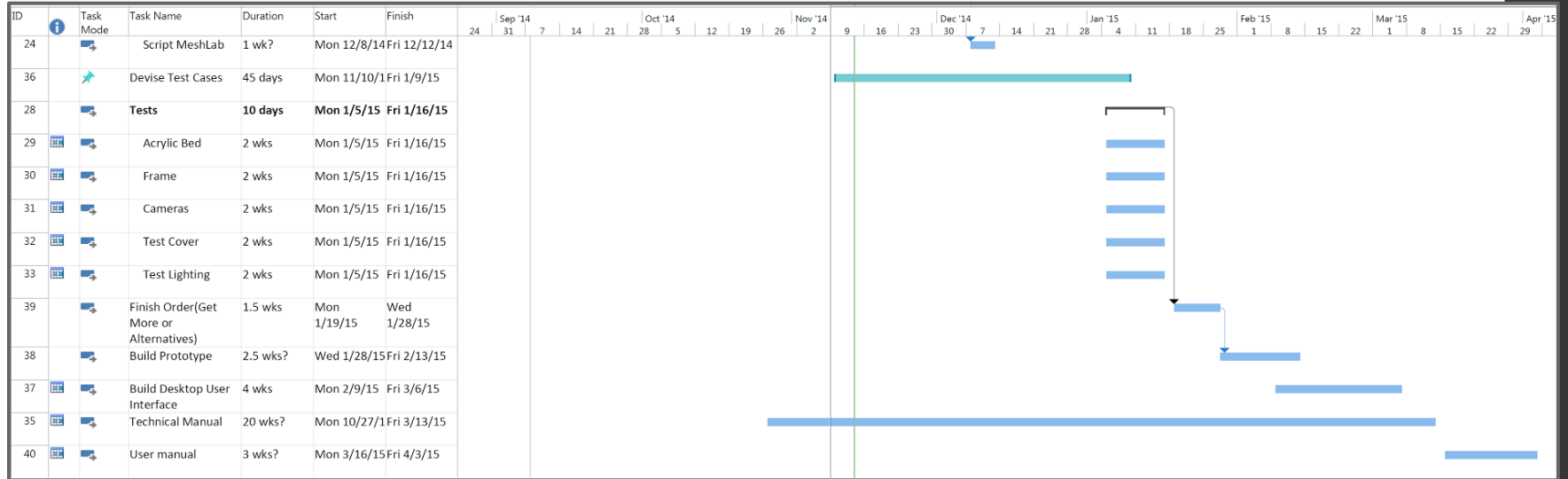RACHELLE DAUPHIN - CpE
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Introduction

Aubrey Tharpe

Schedule

Aubrey Tharpe

Schedule

ID	Task Mode	Task Name	Duration	Start	Finish
24		Script MeshLab	1 wk?	Mon 12/8/14	Fri 12/12/14
36		Devise Test Cases	45 days	Mon 11/10/1	Fri 1/9/15
28		**Tests**	**10 days**	**Mon 1/5/15**	**Fri 1/16/15**
29		Acrylic Bed	2 wks	Mon 1/5/15	Fri 1/16/15
30		Frame	2 wks	Mon 1/5/15	Fri 1/16/15
31		Cameras	2 wks	Mon 1/5/15	Fri 1/16/15
32		Test Cover	2 wks	Mon 1/5/15	Fri 1/16/15
33		Test Lighting	2 wks	Mon 1/5/15	Fri 1/16/15
39		Finish Order(Get More or Alternatives)	1.5 wks	Mon 1/19/15	Wed 1/28/15
38		Build Prototype	2.5 wks?	Wed 1/28/15	Fri 2/13/15
37		Build Desktop User Interface	4 wks	Mon 2/9/15	Fri 3/6/15
35		Technical Manual	20 wks?	Mon 10/27/1	Fri 3/13/15
40		User manual	3 wks?	Mon 3/16/15	Fri 4/3/15

Aubrey Tharpe

Schedule

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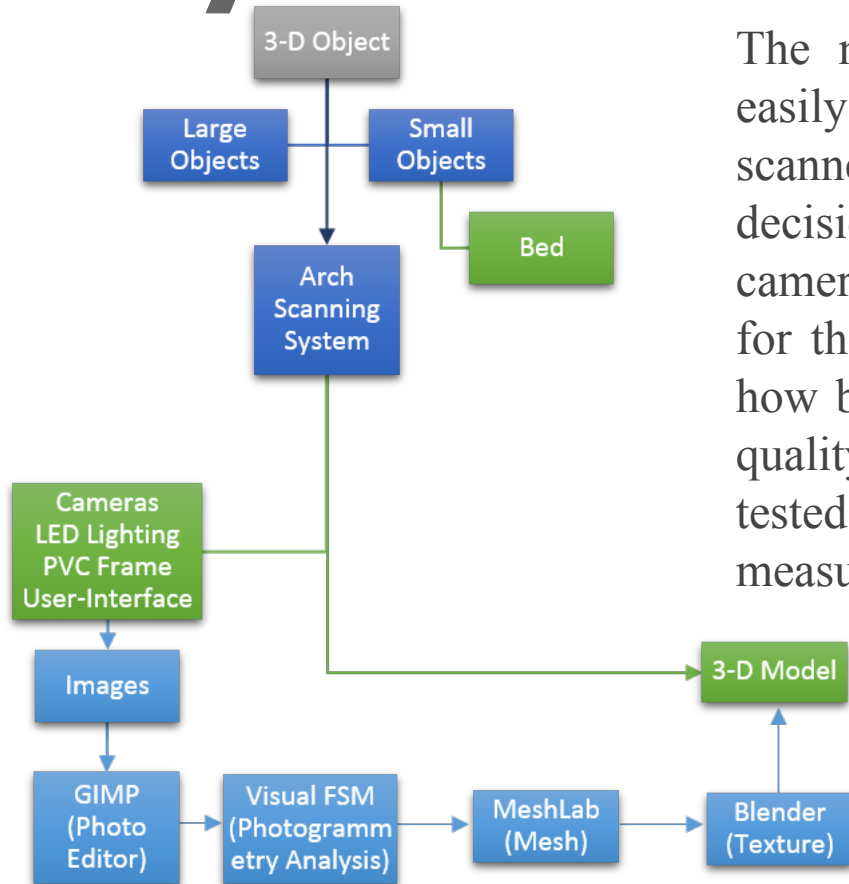
System Overview

The newest addition is the added rail to easily slide the acrylic bed through the scanner for smaller objects. Other major decisions include the using LEDs, 13 cameras, and a green screen to obtain images for the 3D model. Right now the scale on how big the arch should be will rely on the quality of cameras. Once they have been tested the dimensions can be accurately measured.

Aubrey Tharpe

Overview of Materials

Frame:
- The structure will be made from PVC.
- The cover, lights, and cameras will all attach to the frame while the bed will roll on a pair of rails to allow all of the object to be photographed.

Bed:
- The structure will be made from acrylic
- It is a platform to place small objects on for imaging.

Cover:
- The cover will be a "green screen."
- It will cover the inside of the frame to maintain a consistent background in order to isolate the object being scanned.

Lights:
- Lights are 3528 SMD LED strips that will be in two colors to have a more natural lighting effect.
- The strips will be placed in the interior of the frame to illuminate the objects evenly.

Camera:
- The cameras are basic web cameras that will operate through a USB hub.
- There will be 13 cameras in all to photograph the object at many positions.

Software
- Python for scripting which executes instructions to create 3-D model
- GIMP for difference layering to isolate object from background
- Visual SFM for photogrammetry analysis and dense cloud reconstruction
- MeshLab to create a solid mesh from the dense cloud
- Blender to stitch the object's texture to the mesh creating the final product of the 3-D model
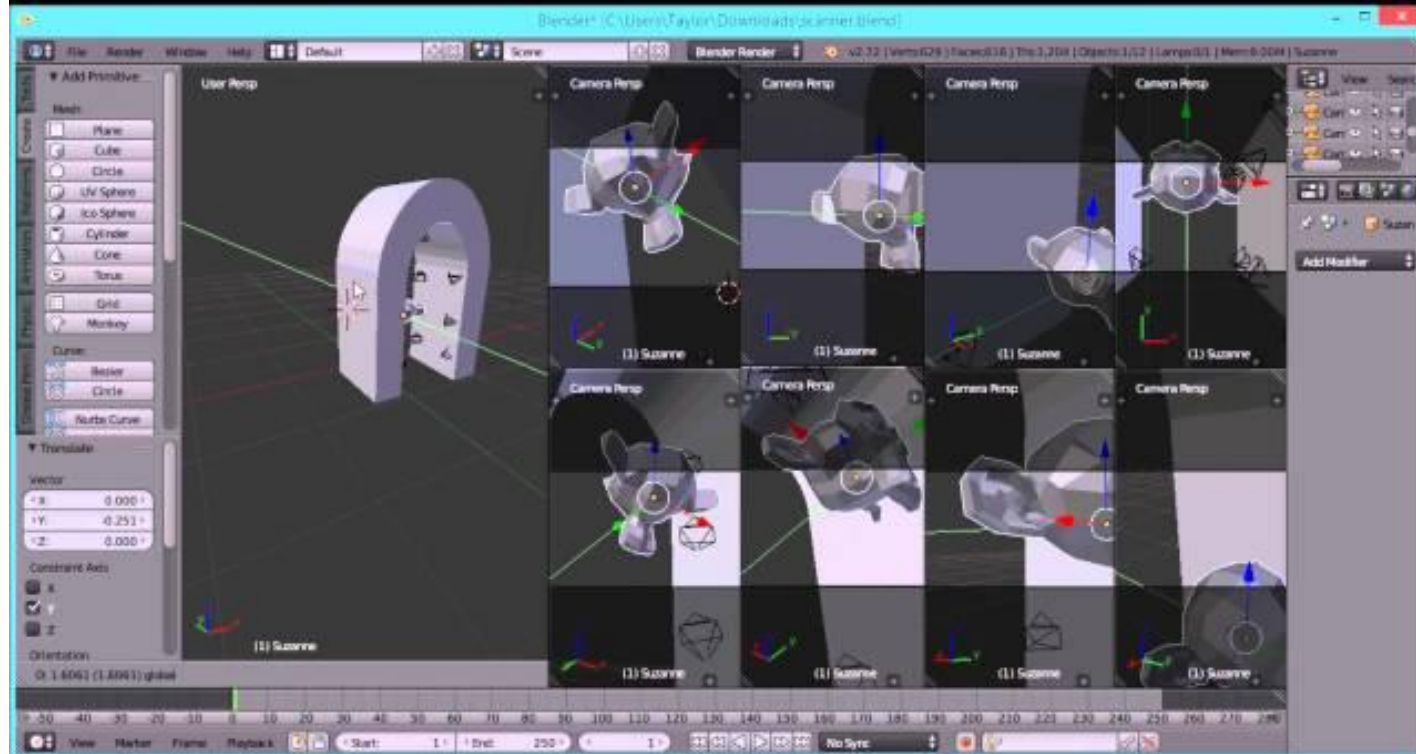
Aubrey Tharpe

Frame

PVC is used to create the arch because it is cheap, easily accessible, easy to repair, and easy to take apart. PVC can be found at local hardware stores which makes it very easy to buy which in turn makes repairs easy. Since the design is suppose to be portable PVC would be the best way to take apart joints and reassemble them.

Taylor Wagner

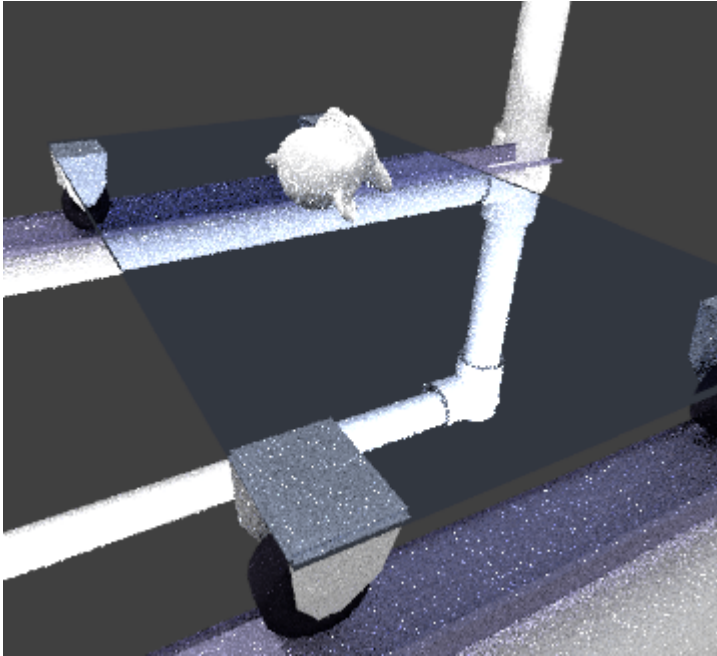# T and L couplers

Taylor Wagner
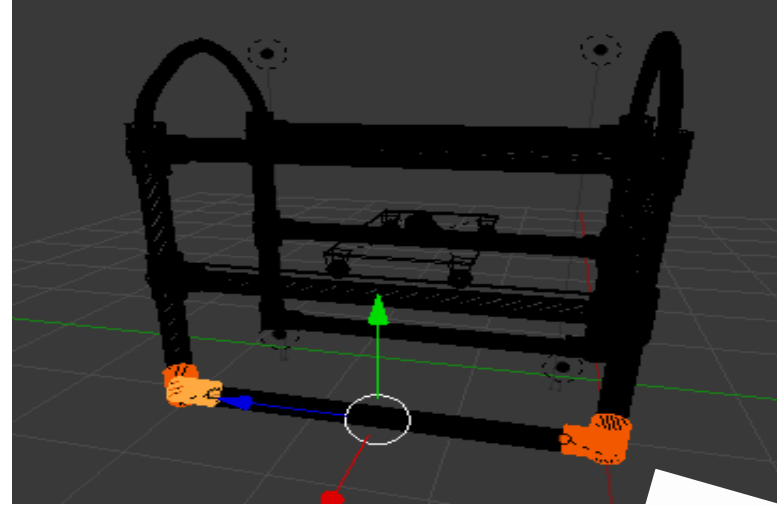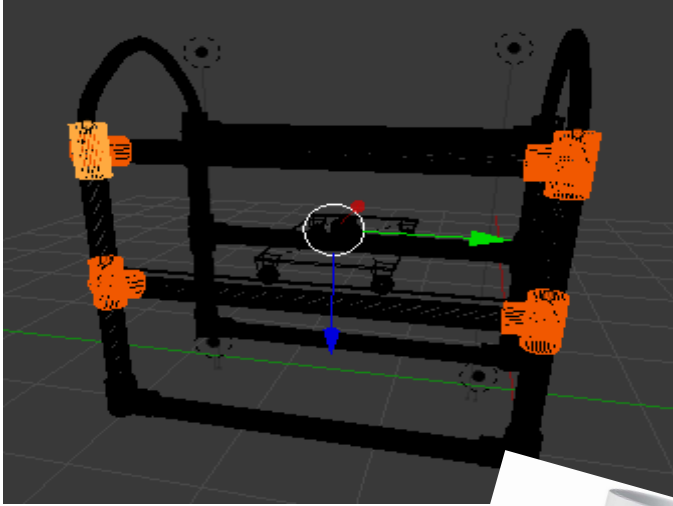
Frame Risks

Poor Arch Construction

1. The PVC pipes must have a diameter small enough to remain bendable to form the arch, but large enough to maintain support.

2. Must be strong enough to hold all components.

3. Make sure all wires can be put inside 2" PVC and the USB hub on the outside.
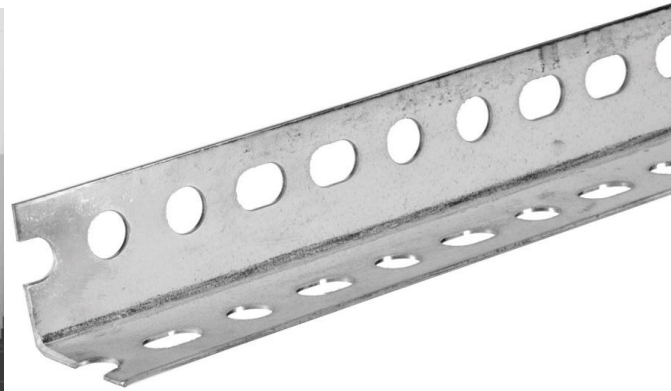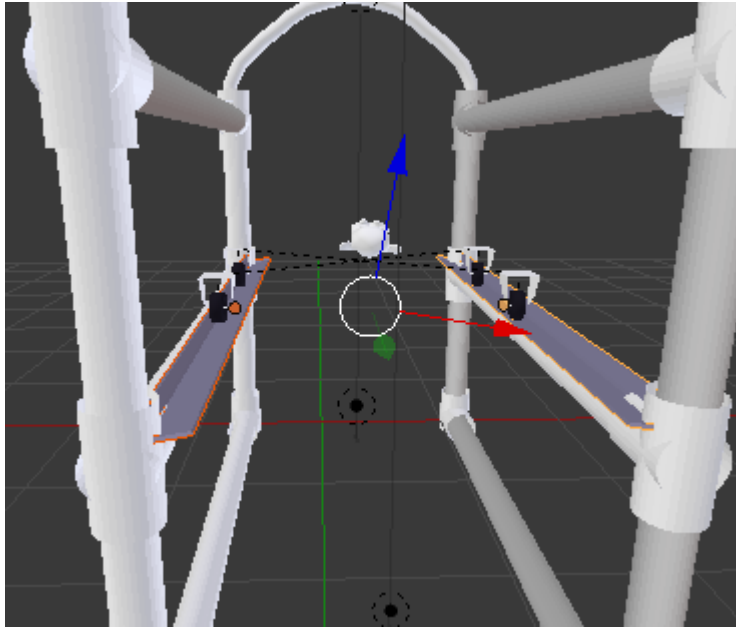
Taylor Wagner

Scanning Bed

Acrylic Sheet:

- Used for smaller objects
- 92% Transparent
- Weight: 10.7 lbs
- 24" x 48"

Wheels:

- Length: 1.5 inches
- Width: 1.69 inches
- Color: Black
- Material: Plastic

Taylor Wagner

Rails

- Length: 6ft
- Width: 2.25 inches
- Height: 1.5 inches
- Material: Steel

Taylor Wagner

Risk For Bed

- Scratching or breaking of acrylic sheet
- Rail not straight
- Wheels breaking
- Wheels wobbling

Taylor Wagner

.Chromakey Muslin Screens

Using a chromakey screen muslin can allow the software to easily detect and remove the background without manual editing.

Muslin is light in weight, so there is no strain on the frame. Manipulating the cover will involve sewing which will not cause discoloration to the cover like glue or tape that could be picked up in the photos.

Specifications

| Dimensions (in)	Weight (lbs)
98 by 48	2

Rachelle Dauphin

Cover Placement/Risks

The green screen will line the interior of the arch. With loops made of the same material sewn to its edges, the cloth will be fasten firmly to the PVC pipes. The loops help with portability. On the roof of the arch, the cover can be split and reattached with a Velcro lining down this location.
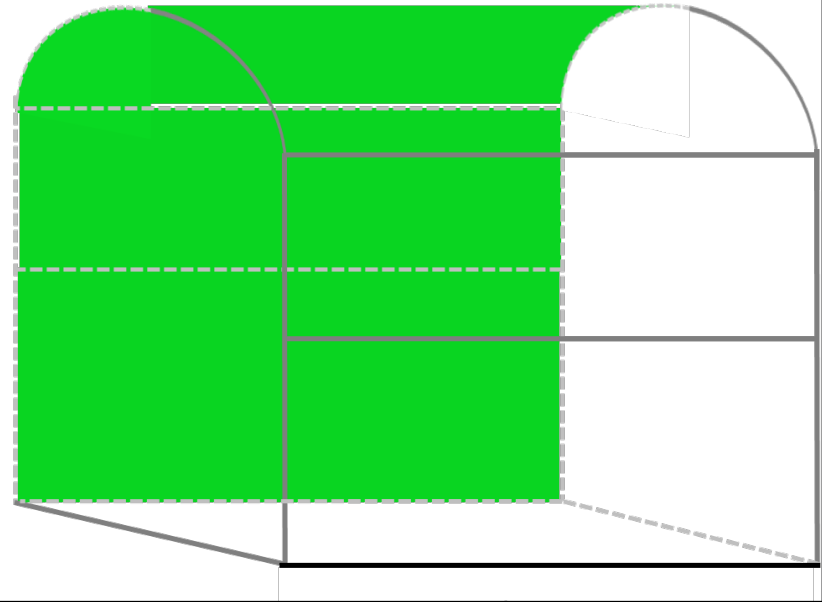
Risk	Probability/Severity	Consequence/Reasoning	Solution
Color Spill	Moderate/Moderate	The color of the cover will reflect onto the object giving the object a tint of the background's hue after the background has been removed from the photo	Attaching foam onto the back of fabric

Rachelle Dauphin

3528 SMD LED Light Strips

Requirement and Specification
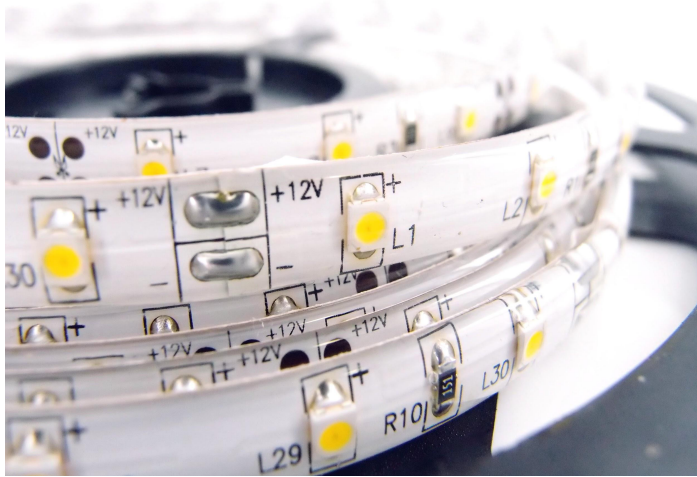
Most light sources produces heat in a form of infrared. Infrared can damage fragile objects and fabric. LED lights does not disperse heat into infrared. Since the artifacts are sensitive to temperature, LED lights are the safest.

Rachelle Dauphin

| Strip Length (m)	5	Width (cm)	0.7874
LED Type	3528 SMD LED	Length (cm)	500
LED Quantity per meter (Units/m)	60	Input Voltage (V)	12
LED Quantity	300	Power (W)	24
Switching Cycle	25000	Lamp Current (mA)	20
Rated Lifetime (h)	50,000	Brightness (lm/m)	300

3528 SMD LED Light Strips

Power Adapter Specifications

- Input Voltage. 110 - 120V AC
- Output Voltage. 12 V DC
- Max Current. 3A
- Work with up to 8.5[m] single color LED strip or up to 5[m] RGB LED strip

Rachelle Dauphin
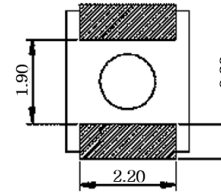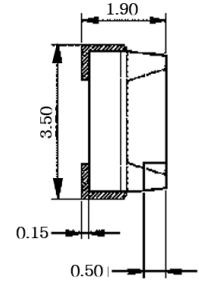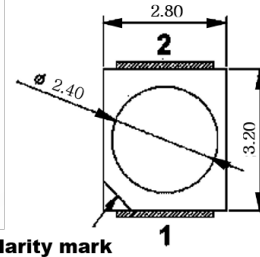
Lighting Placement and Risks

Daylight White
Warm White
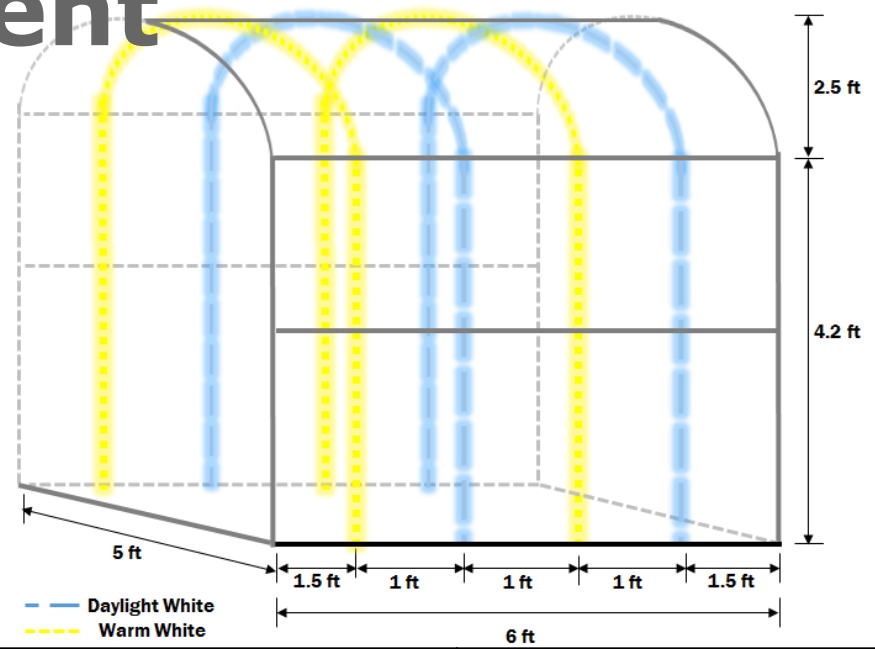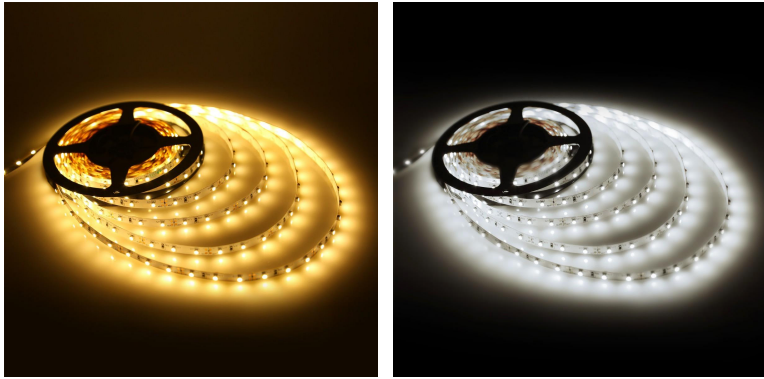
Risk	Probability/Severity	Consequence/Reasoning	Solution
Inefficient Internal Heating removal	low/low	Damage the LED chips	Cut defective section of lights rather than replace entire strip
Overexposure	moderate/high	Photographs will be washed out and unusable	Change strips to 30 per meter rather than 60 per meter

Rachelle Dauphin

Cameras

USB Cable Length (cm)	105
Resolution (MP)	8
Power Supplied	User Interface
Power (mW)	150
OS Compatible	Windows 2000 / XP / Vista / Windows 7 / Windows 8 / Linux

Nicolas Cardenas

Camera

Poor Photograph Collecting

1. Resolution of camera must be at least 8MP
2. Entire object of interest must stay within the DOF or blurry picture may be the outcome.
3. Photos must have a 60%-80% overlap between each other for largest number of auto-correlated points.

Depth of Field

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Camera Placement

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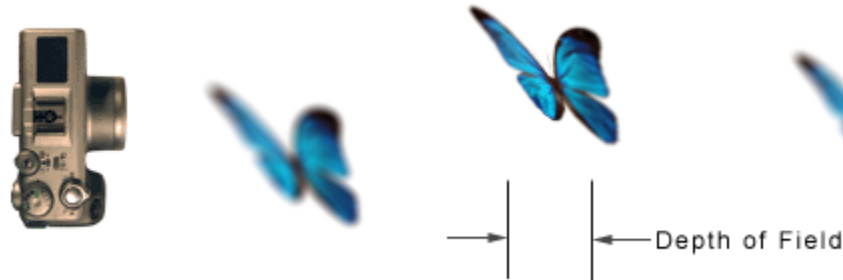
Data Collection Risk (Cont'd)
Artifact Handling Risk

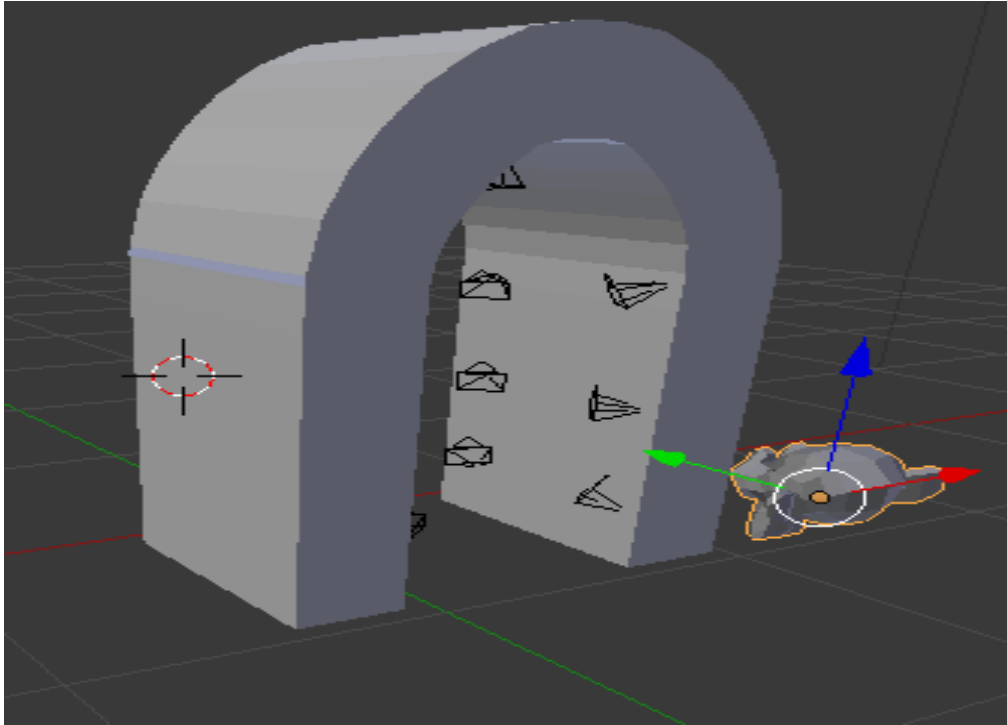1. Relics are very fragile and can be damaged from sunlight, temperature, moisture and careless handling
2. Handler must:
   2.1. Wear gloves when holding/touching artifact because the natural oils on the hands can cause damage
   2.2. Use tweezers and Q tips when manipulating the rigid objects
3. Data will be collected in the media center above the Black Archive Museum rather than shipped to the COE for less handling

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Scripting

Python controls for GIMP, VisualSFM, Meshlab, and Blender

Nicolas Cardenas

Script Pseudo code

```
prompt_for_path();
detect_available_steps(); /*if working dir is empty only
capture is available, if obj file exists all steps
available, etc*/
enable_available_step_buttons();
//Clean background selected
for each in thePath{
    fuzzy_select_green(); /*threshold from fuzzy select
tool may be tweaked*/
    delete_selected();
    export_jpg();
}
```

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Script Pseudo code

```
//generate cloud selected
import_from_thePath();
calculate_mismatches();
generate_sparse_cloud();
generate_dense_cl
//construct surface & texture map is selected
import_cloud();
select_list(); //select list.txt file
delete_sparse(); //remove sparse cloud from current view
import_dense();
poisson_reconstruction();
texture_map_from_registered_rasters();
export_obj();
//open with Blender
import_obj();
```

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Software Risks

- Debugged - Make sure to get out all of the programming errors.

- Communicates with the script - Make sure the script can run through each software.

- User Friendly - Make sure the GUI is easy to use for the consumer.

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Budget (Updated)

Item	Distributer	Costs($)	Quantity	Total ($)
USB 8MP Webcam	TVC-Mall	2.50	13	32.50
Acrylic Sheet	Amazon	52.00	2	104.00
PVC Pipe	Home Depot	3.00	8	24.00
PVC Joints	Home Depot	3.00	14	42.00
98x48 Green/Blue Screen	TubeTape	17.95	2	35.90
Zinc-Plated Steel Slotted Angle	Home Depot	22.00	2	44.00

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Budget (Updated)

Item	Distributer	Costs($)	Quantity	Total ($)
Caster Wheel	Home Depot	3.00	8	24.00
LED Strip Lights	Lighting Ever	10.00	2	20.00
LED Power Adapter	Amazon	10.00	2	20.00
Computer	Walmart	500.00	1	500.00
Other	-	-	-	150.00
Total Cost	-	-	-	996.40

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