Team e10

3D SCANNER

COE ADVISORS
DR. SHONDA BERNADIN
DR. MICHAEL FRANK
DR. VICTOR DEBRUNNER

TEAM MEMBERS
AUBREY THARPE - CpE
TAYLOR WAGNER - CpE
RACHELLE DAUPHIN - CpE
NICOLAS CARDENAS - CpE

Introduction

Aubrey Tharpe

Need and Analysis Summary

The purpose of this project is to design a scanner that implements 3D digital images. There will need to be hardware in order to capture images and software to use photogrammetry. The overall system will contain an arch with cameras and a user friendly python script to create the 3D images. This design will be used to preserve the artifacts in the *Slavery in the Old South* found in FAMU's Black Archives.

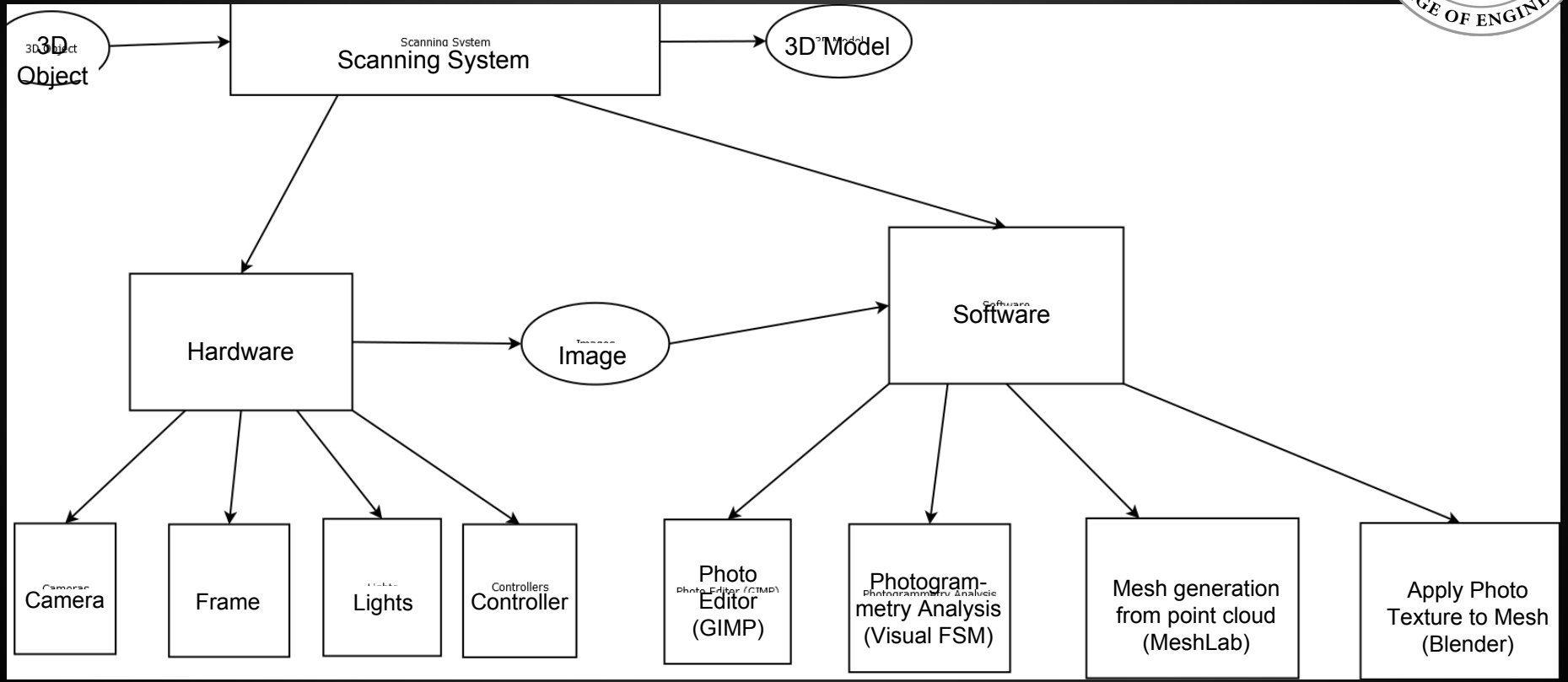
Aubrey Tharpe

Concept Generation and Selection

	Wand	Cage	Arch
Pros	Any size object High portability	Controlled Environment Low portability Open Source Software	Controlled Environment Open Source Software
Cons	Custom Photogrammetry Software Lighting conditions	Low portability Limited object size	Average portability Limited object width

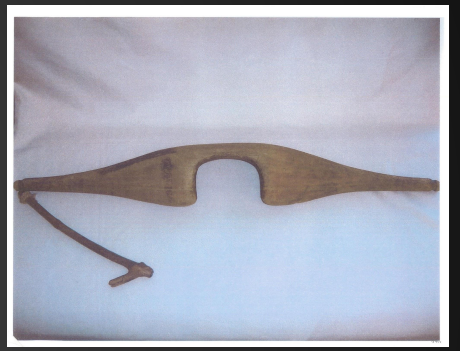
Aubrey Tharpe

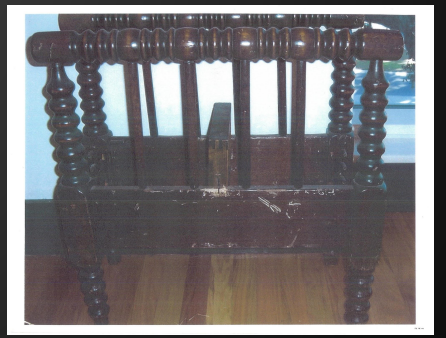
Proposed Design



Aubrey Tharpe

Sample Artifacts





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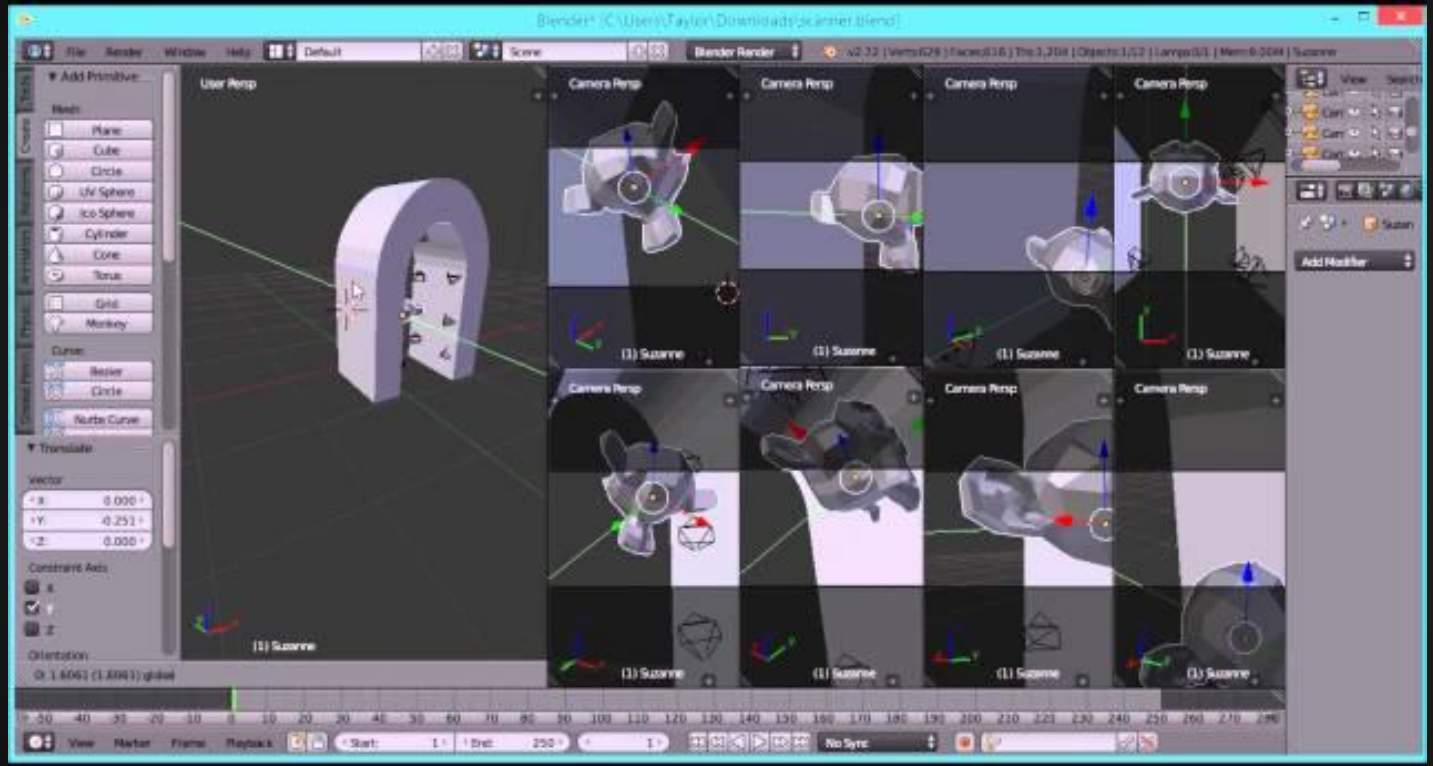


Aubrey Tharpe

Statement of Work

Aubrey Tharpe

Project Management

Ensuring the completion of this project by keeping the team on track

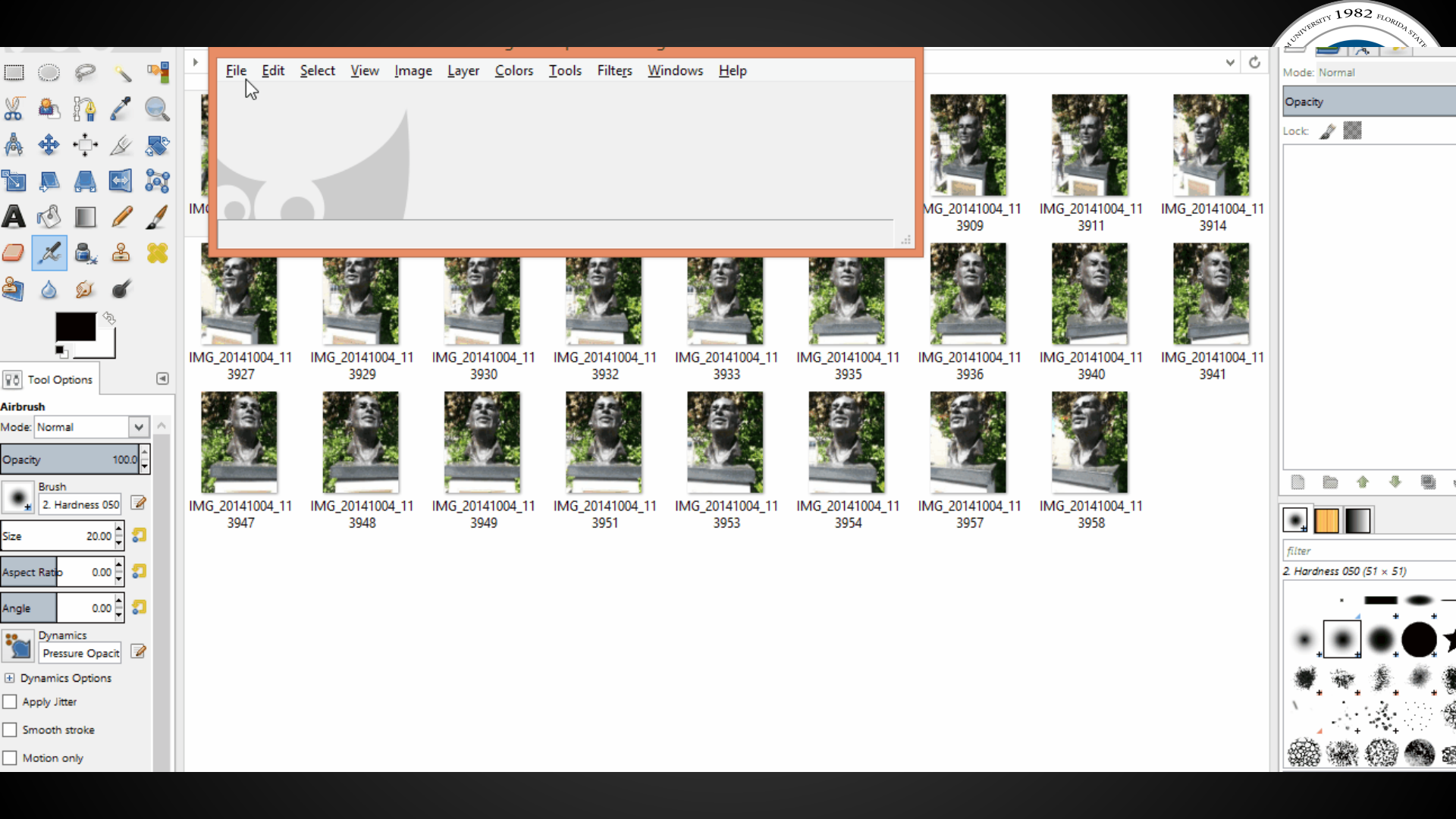
Tasks	Assigned
Scripting	Nick, Taylor, Rachelle
Frame	Taylor, Aubrey
Camera Placement	Taylor
Scanning Sample Collection	Everyone
GUI	Taylor, Aubrey
Manuals	Everyone
Test Plan/Verification	Everyone
Lighting	Rachelle
Cover	Rachelle

Aubrey Tharpe

Scripting

Python controls for GIMP, VisualSFM, Meshlab, and Blender

Taylor Wagner


File Edit Select View Image Layer Colors Tools Filters Windows Help
Tool Options
Airbrush
Mode: Normal
Opacity 100.0
Brush
2. Hardness 050
Size 20.00
Aspect Ratio 0.00
Angle 0.00
Dynamics
Pressure Opacit
Dynamics Options
Apply Jitter
Smooth stroke
Motion only
IMG_20141004_113909
IMG_20141004_113911
IMG_20141004_113914
IMG_20141004_113927
IMG_20141004_113929
IMG_20141004_113930
IMG_20141004_113932
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IMG_20141004_113935
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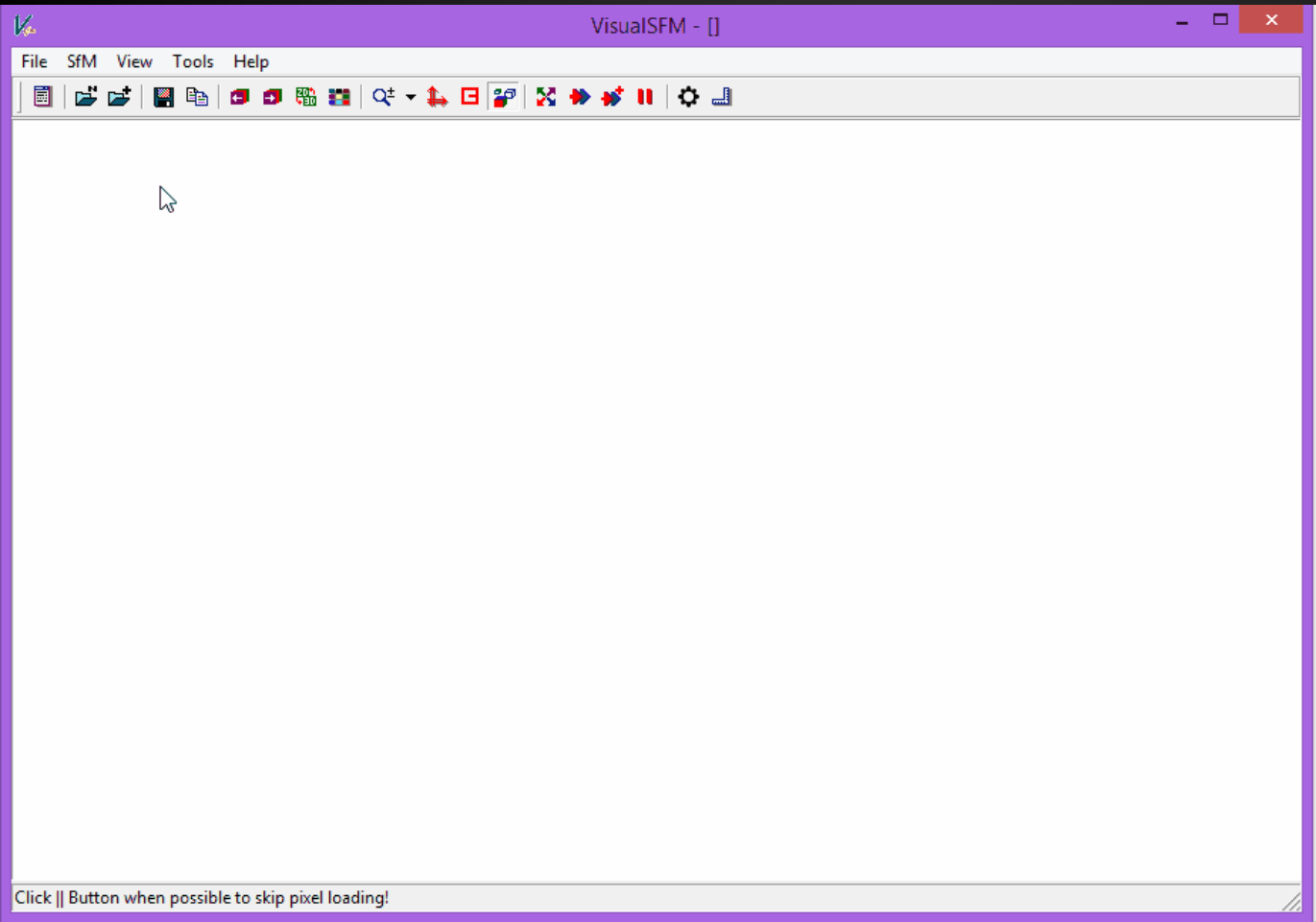
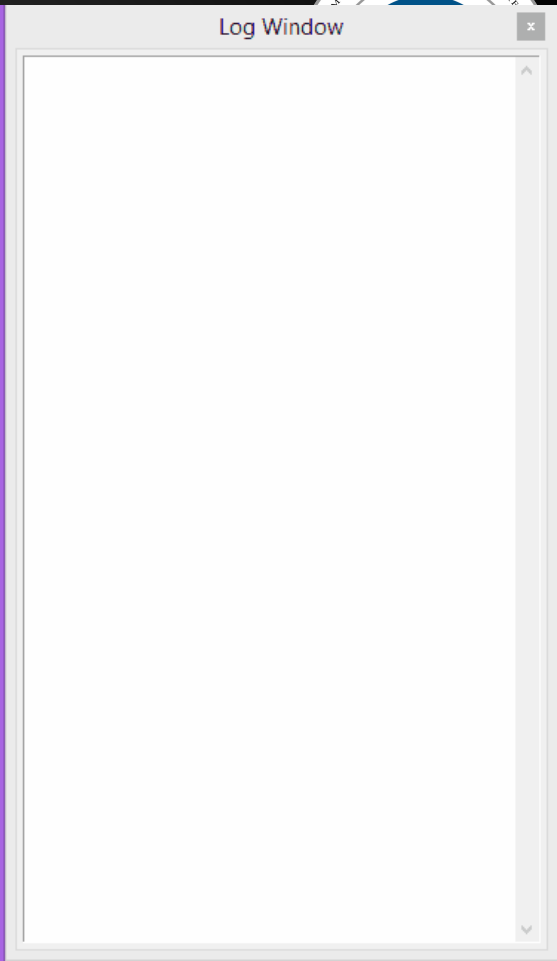
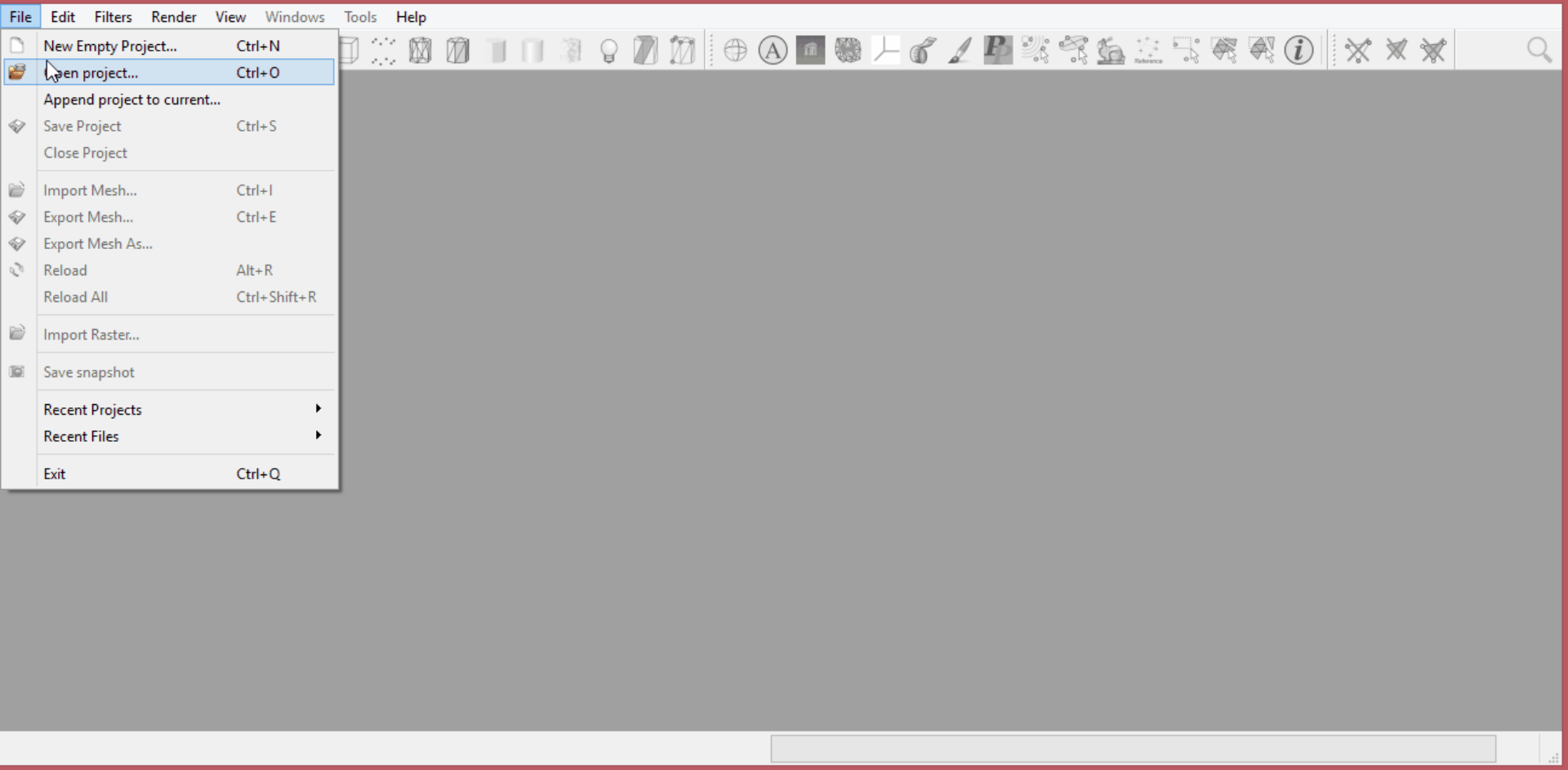
IMG_20141004_113951
IMG_20141004_113953
IMG_20141004_113954
IMG_20141004_113957
IMG_20141004_113958
Mode: Normal
Opacity
Lock:
filter
2. Hardness 050 (51 × 51)

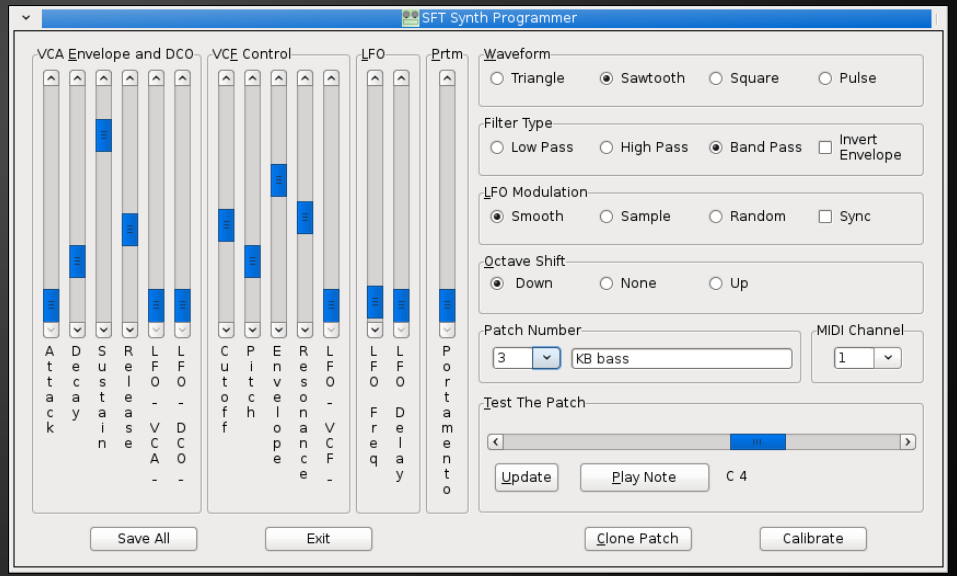

VisualSFM - []
File
SfM
View
Tools
Help
Click || Button when possible to skip pixel loading!


Log Window


File
Edit
Filters
Render
View
Windows
Tools
Help
New Empty Project... Ctrl+N
Open project... Ctrl+O
Append project to current...
Save Project Ctrl+S
Close Project
Import Mesh... Ctrl+I
Export Mesh... Ctrl+E
Export Mesh As...
Reload Alt+R
Reload All Ctrl+Shift+R
Import Raster...
Save snapshot
Recent Projects
Recent Files
Exit Ctrl+Q

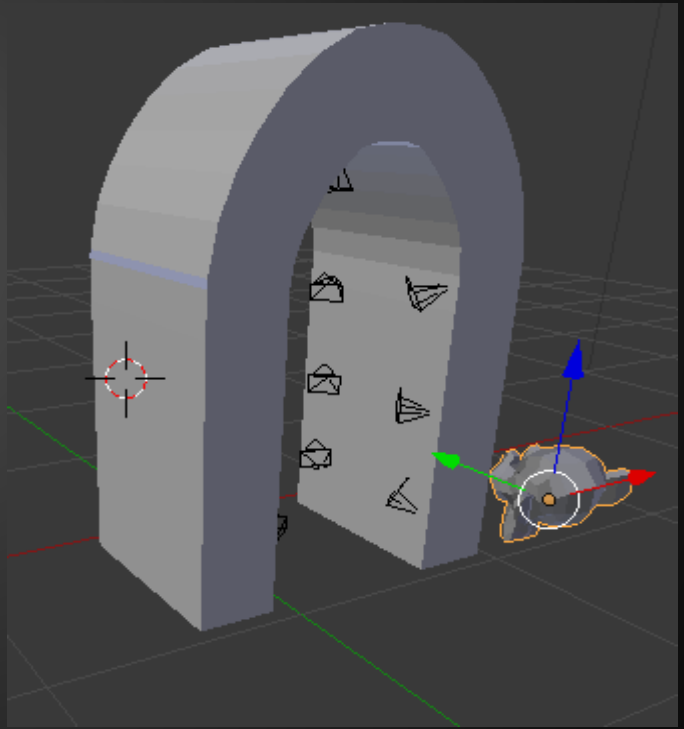
Graphical User Interface

Using TKinter or wxWidgets to provide a simple interface for the script that is interactive to the production



Taylor Wagner

Camera Placement



Taylor Wagner

Frame

Taylor Wagner

Scanning Sample Collection

- Small Objects
- Acrylic Bed
- Large Objects
- 80% matching

Taylor Wagner

Manuals

User Manual

- Step by Step instructions

Technical Manual

- Code instructions

Nicolas Cardenas

Test Plan/Verification Plan

1. Software
2. Python Script
3. Cameras and Lighting
4. Arch
5. Overall Inspection
6. Customer's Satisfaction

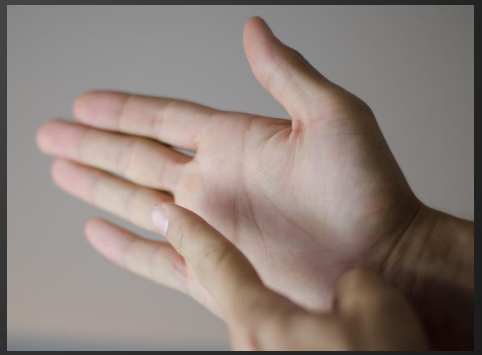
Nicolas Cardenas

Lighting

- Soft light required to evenly illuminate the object of interest
- Hard Light Source
  - Light Diffuser can be used

Light Diffuser

Hard Light



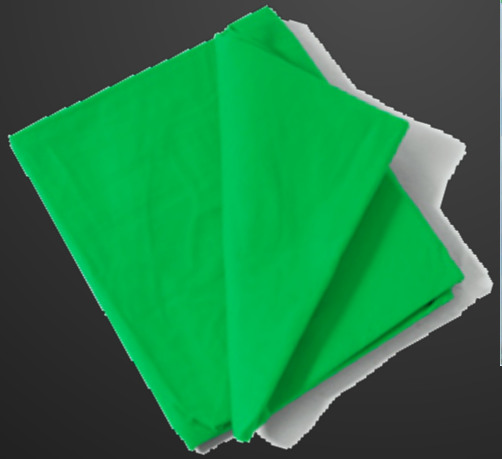
Soft Light

Rachelle Dauphin

Cover

Solid colored material that covers the frame of the arch for a consistent background as the objects are captured when passing through.

- Cost efficient
- Chromakey



Rachelle Dauphin

Risk Assessment

Software Risks

Software Dependency

1. One or more programs can have an error in the middle of executing the script.

2. One or more programs could output faulty results which would be fed into another program during the execution.

VisualSFM Minimal Requirements

1. Requires GPU memory minimum of 1GB, otherwise:

    a. Can lead to less feature detections when forming the point cloud

    b. Resolution of photos will be reduce by ½ if too high

Rachelle Dauphin

Hardware Risks

Poor Frame Construction

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

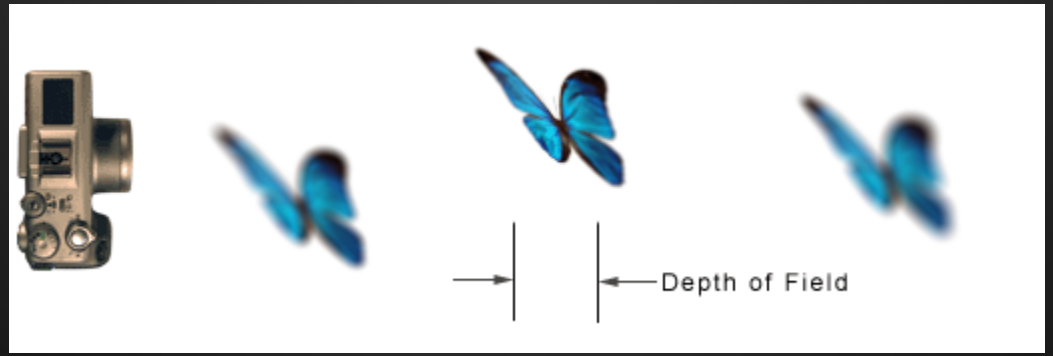
2. The cover cannot be glued or taped together because this may cause discoloration to the paper or sheen which could be picked up in the photos.

Rachelle Dauphin

Data Collection Risk

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.



Rachelle Dauphin

Data Collection Risk (Cont'd)

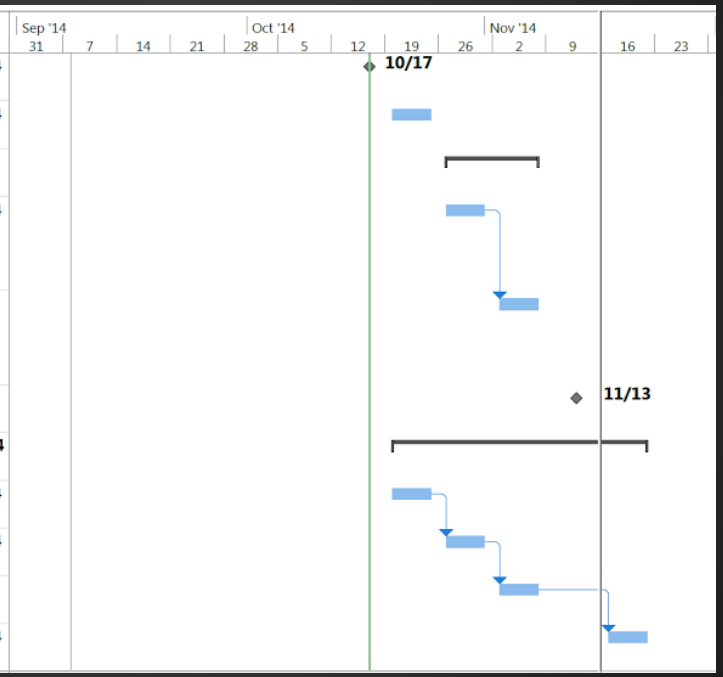
Artifact Handling Risk

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

Rachelle Dauphin

Schedule

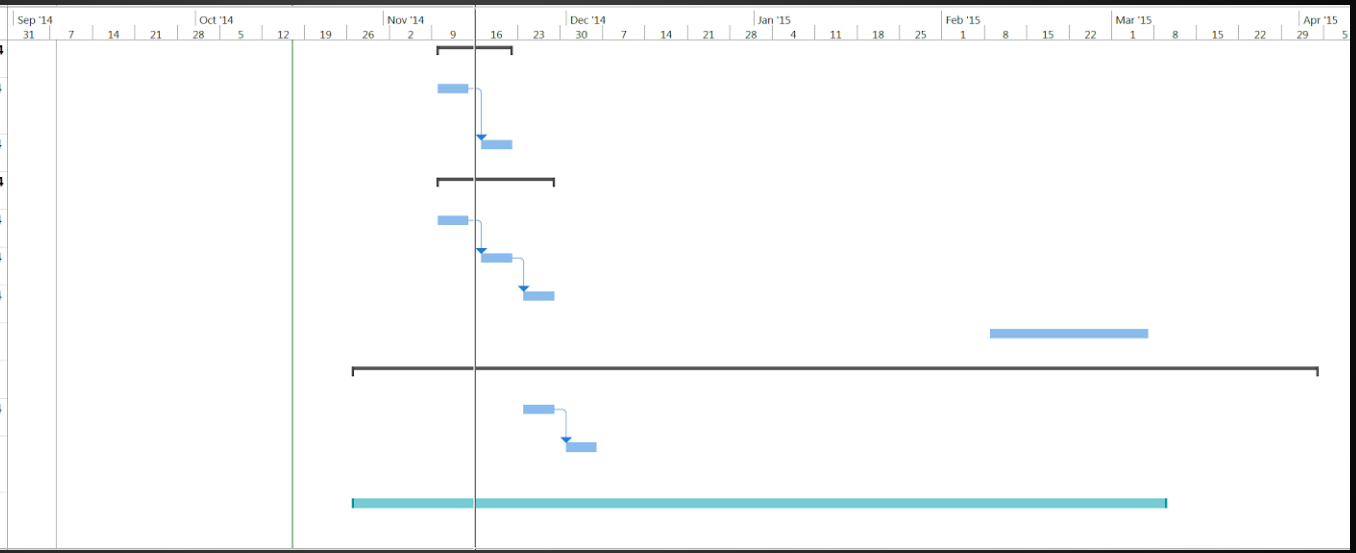
ID	Task Mode	Task Name	Duration	Start	Finish
35		PP&SOW	0 days	Fri 10/17/14	Fri 10/17/14
5		Arc Path	1 wk?	Mon 10/20/1	Fri 10/24/14
6		**Lighting Design**	**10 days?**	**Mon 10/27/1**	**Fri 11/7/14**
8		Consider all lighting solutions and order	1 wk	Mon 10/27/14	Fri 10/31/14
7		Test Lighting to ensure lighting is optimal for 3D model	1 wk?	Mon 11/3/14	Fri 11/7/14
36		System Level Design Review	0 days	Thu 11/13/14	Thu 11/13/14
9		**Script Software together**	**25 days?**	**Mon 10/20/14**	**Fri 11/21/14**
13		Script Gimp	1 wk?	Mon 10/20/1	Fri 10/24/14
12		Script VisualSFM	1 wk?	Mon 10/27/1	Fri 10/31/14
11		Script MeshLab	1 wk?	Mon 11/3/14	Fri 11/7/14
10		Script Blender	1 wk?	Mon 11/17/1	Fri 11/21/14



Nicolas Cardenas

Schedule

ID	Task Mode	Task Name	Duration	Start	Finish
14		**Cover Design**	**10 days?**	**Mon 11/10/1**	**Fri 11/21/14**
16		Consider Alternatives and order	1 wk?	Mon 11/10/14	Fri 11/14/14
15		Test choice	1 wk?	Mon 11/17/1	Fri 11/21/14
1		**Build Frame**	**15 days?**	**Mon 11/10/1**	**Fri 11/28/14**
2		List parts and Order	1 wk?	Mon 11/10/14	Fri 11/14/14
4		Build Skeleton Frame	1 wk?	Mon 11/17/14	Fri 11/21/14
3		Acrylic Bed	1 wk?	Mon 11/24/1	Fri 11/28/14
37		Build Desktop User Interface	4 wks	Mon 2/9/15	Fri 3/6/15
17		**Camera Placement**	**115 days?**	**Mon 10/27/1**	**Fri 4/3/15**
34		Consider options and order	1 wk	Mon 11/24/14	Fri 11/28/14
18		Test choice, find optimal placement	1 wk?	Mon 12/1/14	Fri 12/5/14
19		Add information to Technical Manual	19.2 wks	Mon 10/27/14	Mon 3/9/15



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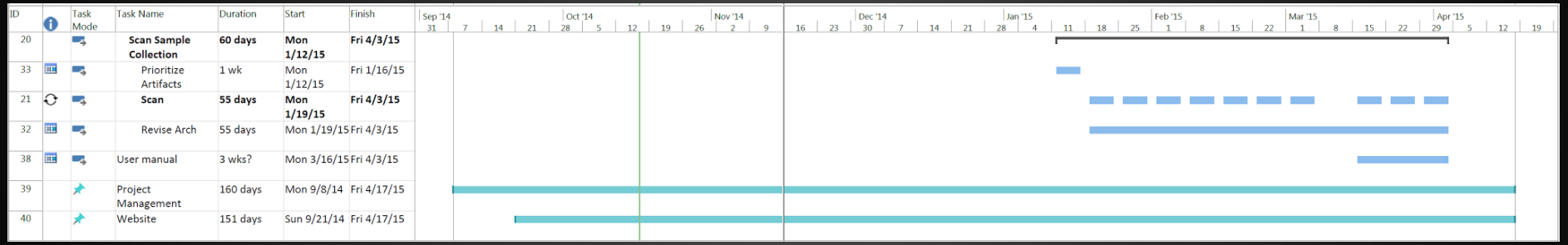
Schedule



ID	Task Mode	Task Name	Duration	Start	Finish
20		**Scan Sample Collection**	**60 days**	**Mon 1/12/15**	**Fri 4/3/15**
33		Prioritize Artifacts	1 wk	Mon 1/12/15	Fri 1/16/15
21		**Scan**	**55 days**	**Mon 1/19/15**	**Fri 4/3/15**
32		Revise Arch	55 days	Mon 1/19/15	Fri 4/3/15
38		User manual	3 wks?	Mon 3/16/15	Fri 4/3/15
39		Project Management	160 days	Mon 9/8/14	Fri 4/17/15
40		Website	151 days	Sun 9/21/14	Fri 4/17/15

Nicolas Cardenas

Budget Estimation

D.Expense				
Item	Distributer	Cost($)	Quantity	Total ($)
USB 8MP Webcam	TVC-Mall	2.50	13	32.50
Acrylic Sheet	Amazon	15.00	1	15.00
PVC Pipe	Home Depot	3.00	8	24.00
PVC Joint	Home Depot	0.50	4	4.00
USB Hub	Amazon	4.00	2	8.00
Computer	Walmart	500.00	1	500.00
Green Screen Muslin 5 x 7	TubeTape	17.95	2	35.90
Other(i.e.lights, shipping)	-	-	-	150
Total	-	-		736.90

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Budget Estimation

Budget Estimation (Cont'd)

Options

Item	Distributer	Costs($)	Quantity	Total ($)
Image Sensor	Uctronics	20.00	13	260.00
Arduino	Amazon	18.00	1	18.00
Bluetooth	Adafruit	20.00	1	20.00

Deliverables

Hardware:

Arch

Software:

VisualSFM, MeshLab, Blender, and Python

Manuals:

Technical manual and User Friendly Manual

Nicolas Cardenas