



TEAM B3

2D23D

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USE CASES

Provide a commercially usable 3D camera system to be able to reconstruct an object into a usable 3D format

Software

Signals

Hardware

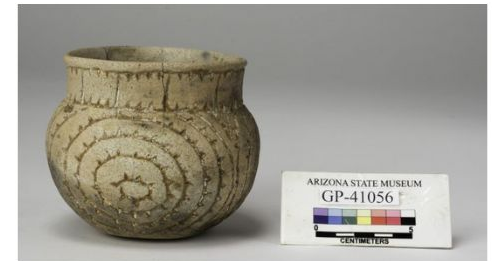
Circuits



Input



Output



REQUIREMENTS

1

Accuracy

- 90% of the points are within 1 mm of the ground truth model
- 100% of the surface points are within 1 cm

3

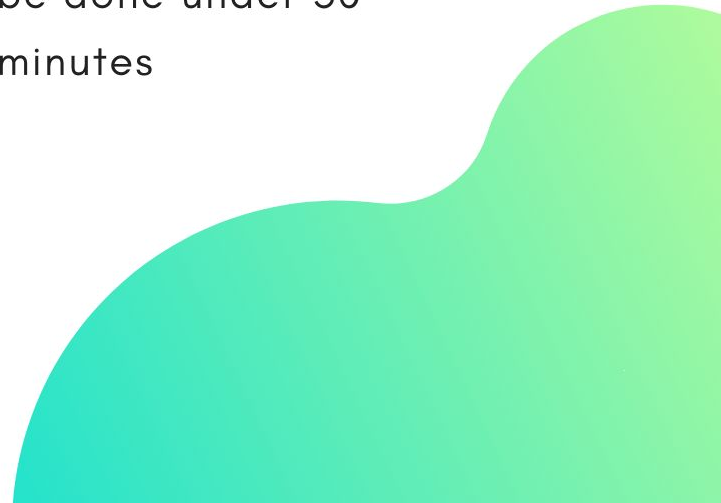
Affordability

- Well within \$600 budget

2

Efficiency

- Reconstruction should be done under 30 minutes



REQUIREMENTS

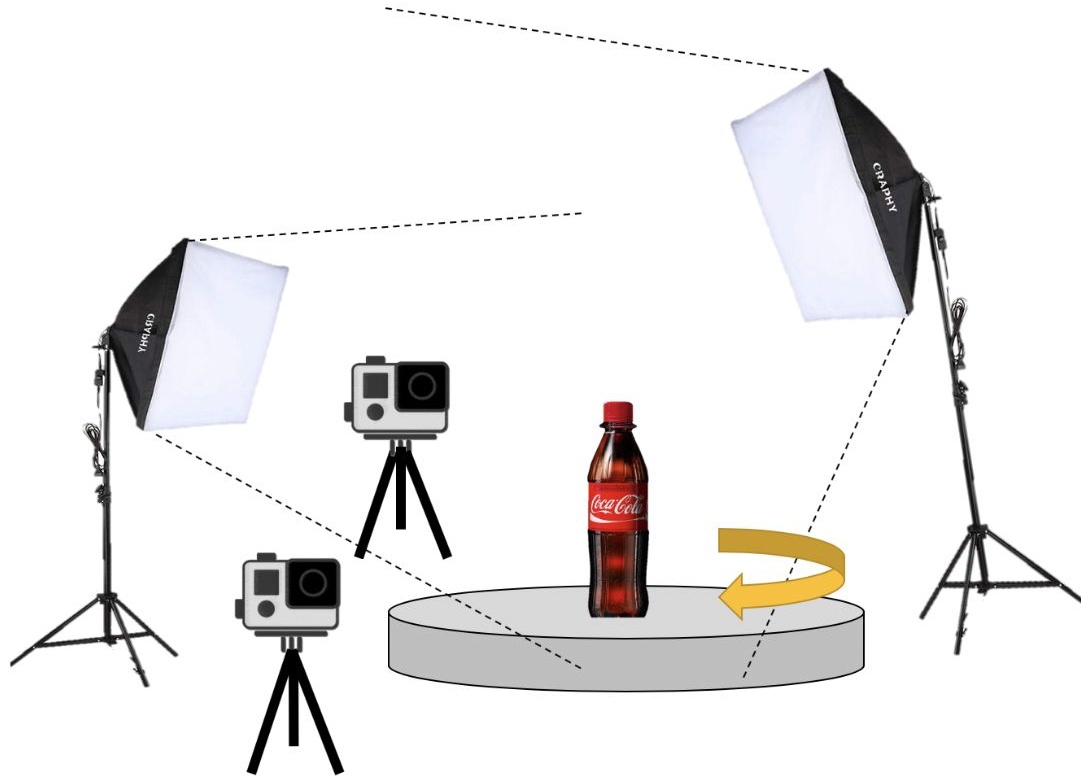
4 Usability

- Outputs a format that is usable to the general audience. Can be rendered with popular modeling software

5 Portability

- Fits on a desk and easy to move (with 15 kg)
- Does not require complex setup

APPROXIMATE SETUP



SOLUTION APPROACH

Input sensor

Multiple Cameras vs Laser Array

Rotation

Rotating Platform vs Rotating Camera

Number of Sensors

2 vs 4 Cameras



SOLUTION APPROACH

Object Detection

- OpenCV

Lighting

Two lights with diffuser

- To illuminate the object (key light)
- To illuminate the shadows cast by key light

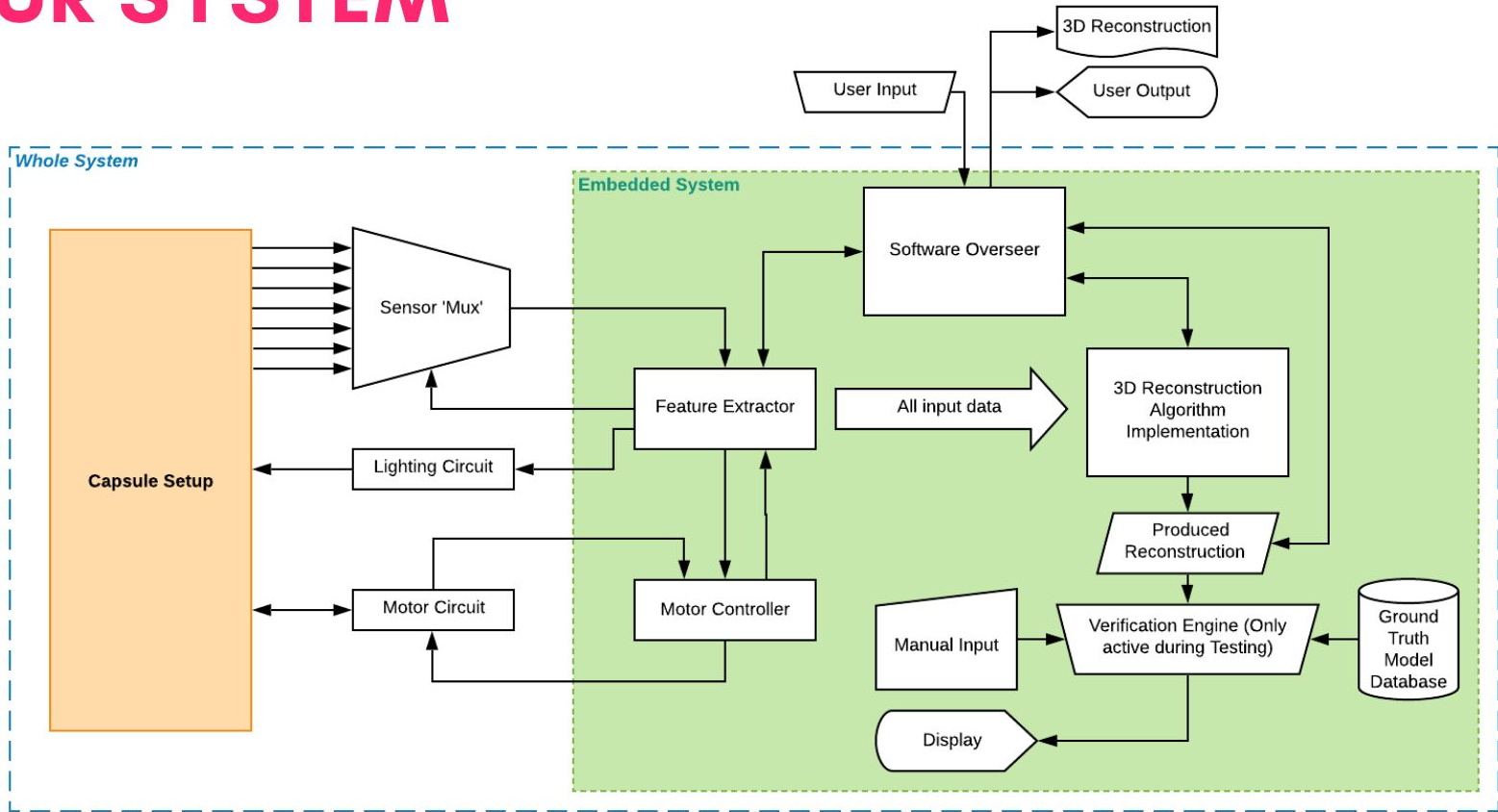
Reconstruction Techniques

- Convolutional Neural Networks
- Generative Adversarial Networks
- Multi-view Stereo Reconstruction
- Structure from Motion

Representation

- Mesh vs Point Cloud Representation

OUR SYSTEM



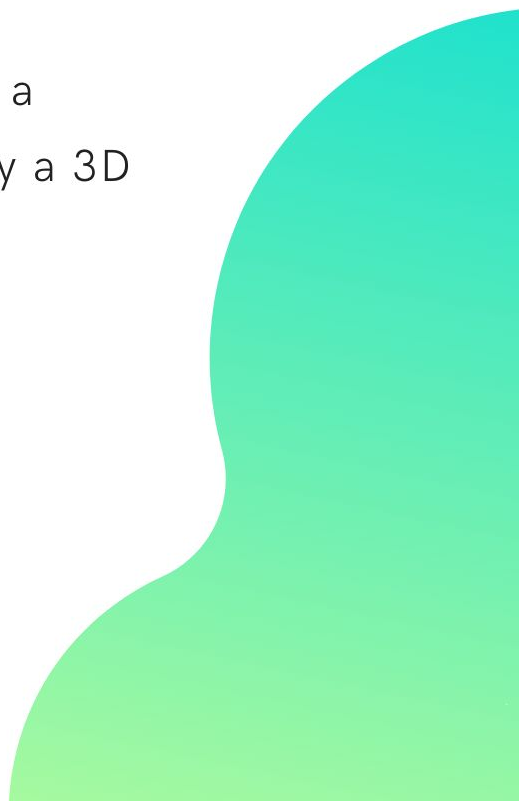
Testing, Verification, and Metrics

Accuracy

- Find existing accurate 3D models of common objects, 3D print them, and use our system to reconstruct and measure against original model
- Grid of points
- Closest distance to a point in the ground truth model

Usability

- Able to convert to a format readable by a 3D printer



Testing, Verification, and Metrics

Affordability

- All parts combined cost less than \$600

Portability

- Weighs less than 5 kg

Efficiency

- Average reconstruction time should be within 30 minutes
- Benchmark is performed on our target device with NVIDIA GPU



TASKS AND DIVISION OF LABOR



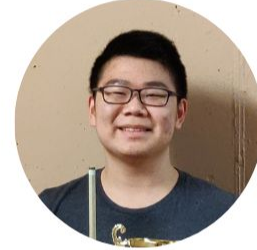
Alex Patel

- Testing benchmark
- Camera Setup
- Reconstruction Algorithm



Chakara Owarang

- Rotational Mechanism
- Feature Extraction and Control



Jeremy Leung

- Database Construction
- Reconstruction Algorithm
- Lighting Setup

SCHEDULE

- Explore reconstruction algorithms and tradeoffs
- Determine model components for the reconstruction algo...
- Determine camera/sensor setup
- Design camera and platform layout
- Design rotational mechanism
- Determine lighting requirements
- Design lighting layout and circuit
- Find specific parts for purchase and determine total cost
- Create (and present) Design Review presentation
- Slack before Design Presentation
- Design Document
- Order components
- Assemble camera capsule
- Wire up lighting circuit
- Wire up motor control circuit
- Implement rotational controller
- Assemble the whole platform setup
- Early testing of image capture, analysis of image quality,...
- Find database of ground-truth models we can test on
- Write testing benchmark code to determine accuracy of a...
- Implement feature extraction from images
- Spring break
- Implement and test components of reconstruction algorit...
- Combine modeling components of reconstruction algorit...
- Test and verify across many samples
- Improve reconstruction algorithm before in lab demo
- Make necessary fixes after in lab demo
- Write final report
- Create (and present) Final Presentation
- Slack before Final Report

