



CS 445 Computational Photography

# FINAL PROJECT

Deepti Sharma

[deeptis2@illinois.edu](mailto:deeptis2@illinois.edu)



## Table of Contents

<b>OVERVIEW.....</b>	<b>2</b>
<b>METHODOLOGY .....</b>	<b>2</b>
<b>EVALUATION.....</b>	<b>2</b>
<b>IMPLEMENTATION .....</b>	<b>2</b>
<b>PANORAMA FROM VIDEO .....</b>	<b>2</b>
<b>SEGMENTATION .....</b>	<b>3</b>
<b>BLENDING .....</b>	<b>3</b>
<b>FINAL VIDEO.....</b>	<b>3</b>
<b>RESULTS .....</b>	<b>3</b>
<b>SEGMENTATION .....</b>	<b>3</b>
<b>HEADBOARD .....</b>	<b>3</b>
<b>SIDE-TABLE .....</b>	<b>4</b>
<b>BEDSIDE PANEL .....</b>	<b>4</b>
<b>RESULT 1 .....</b>	<b>4</b>
<b>RESULT 2 .....</b>	<b>5</b>
<b>RESULT: CAT ON BED.....</b>	<b>5</b>
<b>VIDEOS .....</b>	<b>6</b>
<b>PROJECT FILES .....</b>	<b>6</b>
<b>OBSERVATIONS .....</b>	<b>6</b>
<b>REFERENCES .....</b>	<b>6</b>

# CS 445 Computational Photography

Final Project : Spring 2020

Team: Deepti Sharma ([deeptis2@illinois.edu](mailto:deeptis2@illinois.edu))

**Project Topic:** Replace items/objects/ from a Video

## Overview

While re-decorating or renovating a house, an interior designer may receive photos or video of the location/house which could be already fitted with existing items. Some re-decoration work may require digital removal of existing items from the scene before new items can be added in place. Items being replaced could be furniture items or more structural elements in the house such as doors/partition walls etc. Using this technique, designers could share their ideas to the clients and get feedback on their remodeling / renovation suggestions.

## Methodology

Edge Detection to identify object boundaries

Removal of object from all frames

Add new objects in scene, using compositing and blending technique

Use hole filling technique to fill the gaps

## Evaluation

Smooth edge detection and boundaries

Lighting adjustment for proper blending of new items

Two results for project for quality assurance

## Implementation

### Panorama from Video

- Shot a short 15 seconds video at Home
- Converted Video to Individual frames
- Combined all frames to Generate Panoramic View

## Segmentation

- Used the panorama to segment objects
  - Leveraged **cv2.grabCut()** for created segments
- Edges are not very sharp
  - Since in the image *background and foreground colors were very similar*, some of the color segmentation techniques did not work
  - Even with Intelligent Scissors it was hard to get the boundaries smoothly
  - Due to higher luminance closer to the back wall, edge of the bed is very difficult to find
  - Tried image contrast enhancement using Gamma Correction
  - But that too did show much improvements selection
- Difference of Gaussian to identify Newly segmented Area
- Used this as a Mask for segmented area
- Added new Textures in the Masked Region
- To add effects of transition, masked images are added in between frames
- The final videos are uploaded to Vimeo

## Blending

- After texture inclusion, added a new outside object to the original content
- Additionally, added a 'Sleeping Cat' on bed using Mixed Gradient Descent
- Code for Poisson blending and Mixed gradient descent is in **[blending.py](#)**

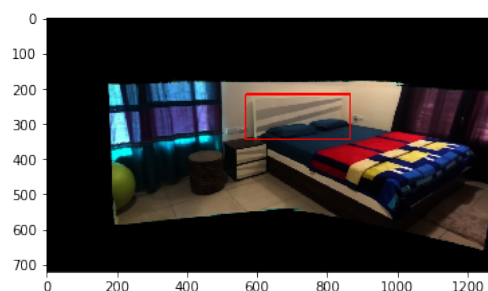
## Final Video

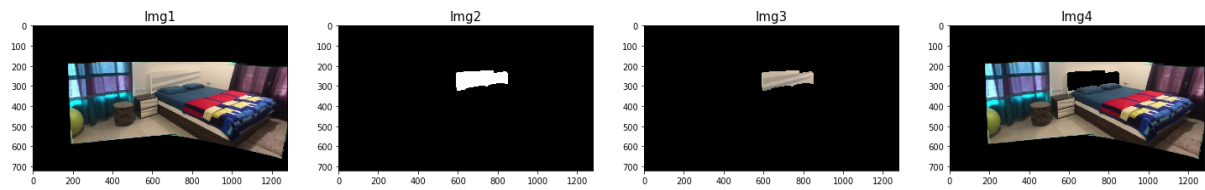
- There were 250 frames in the original video
- On the original frames, 2 different textures are applied to the masked regions to replace with new Textures
- To simulate continuous back and forth camera movements
  - First original frames are shown
  - Then the frames with first texture are displayed in reverse order
  - Then again frames with second texture are displayed in forward fashion

## Results

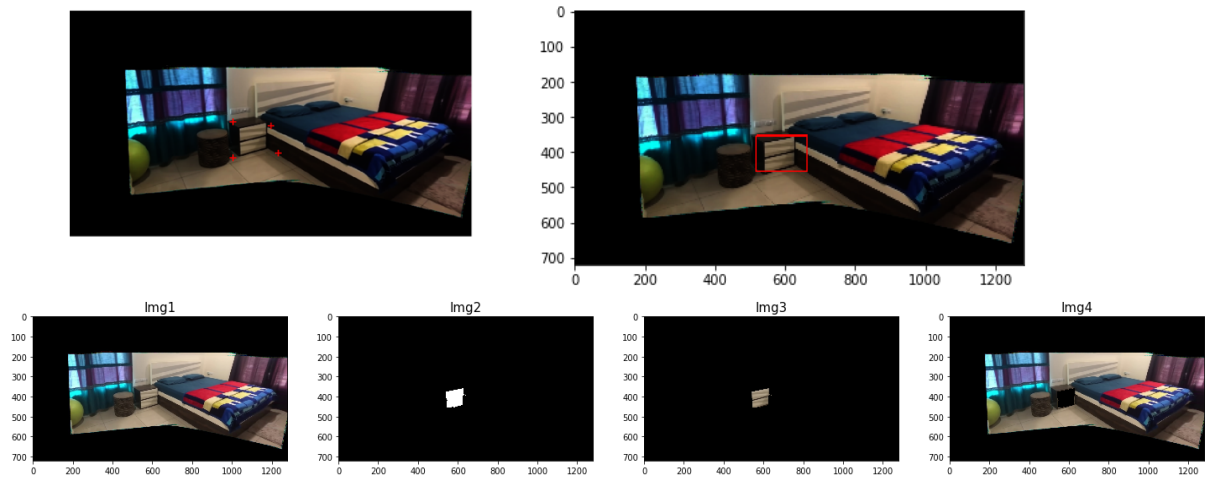
### Segmentation

#### Headboard



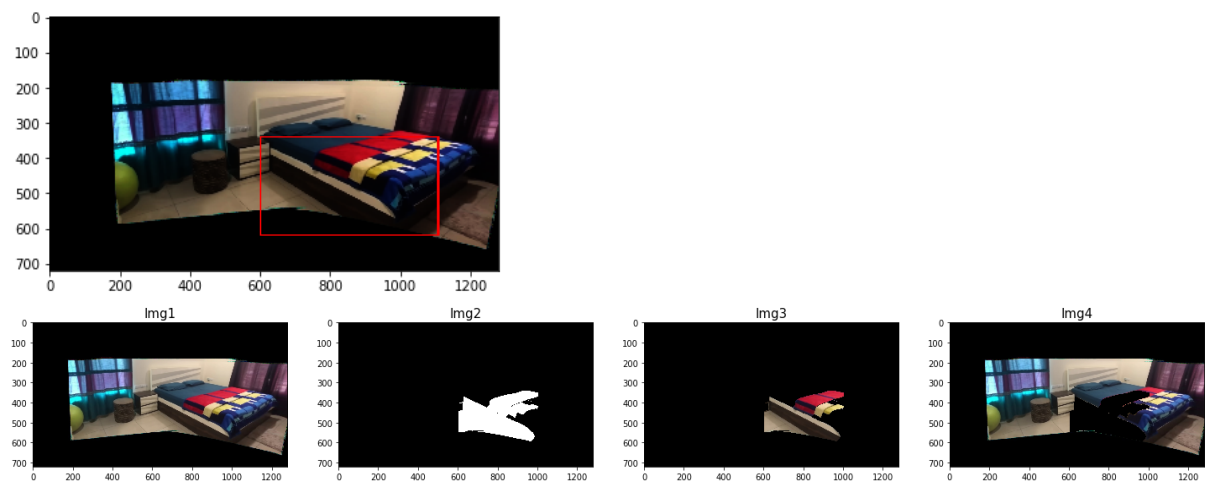


Side-table



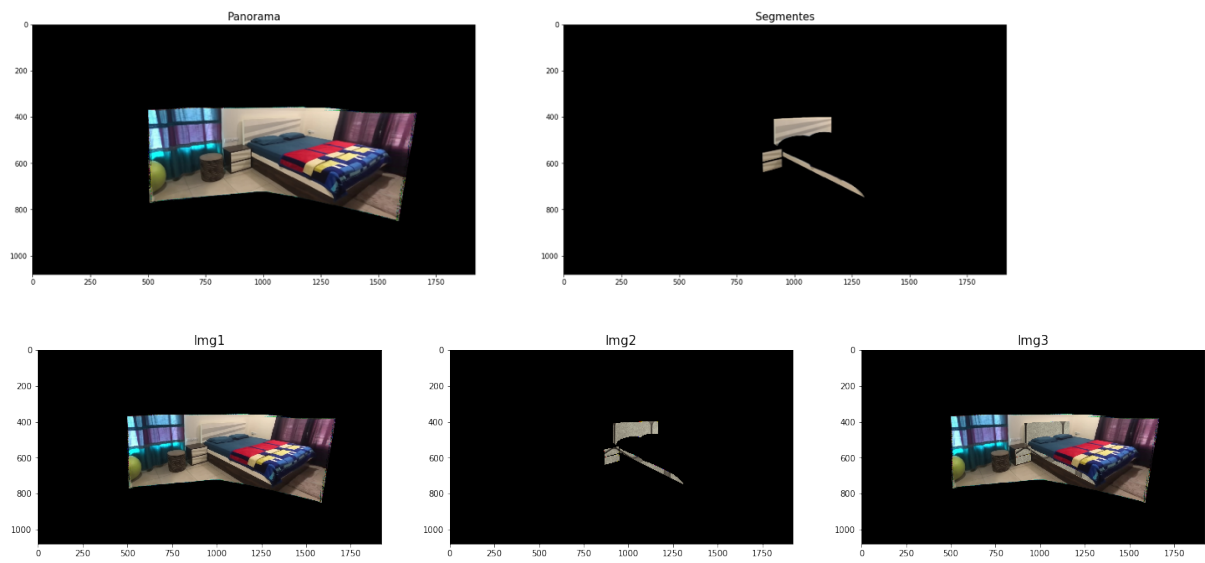
Bedside panel

Example of bad segmentation



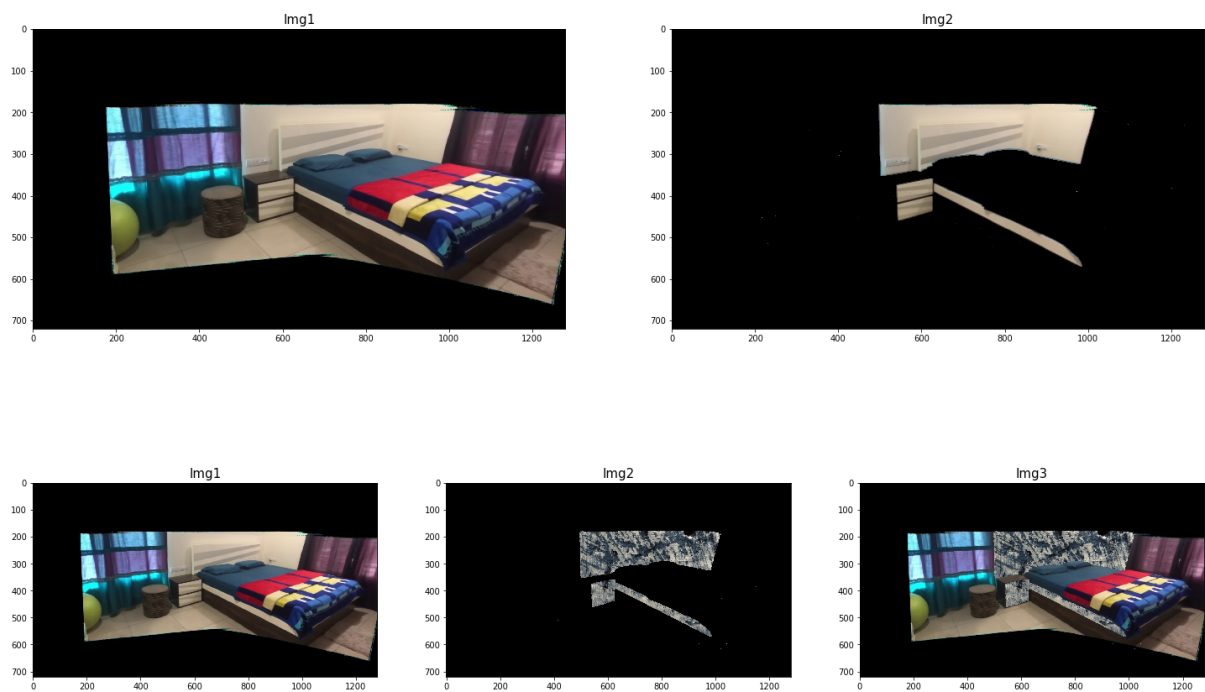
Result 1

(after some additional runtime filtering)

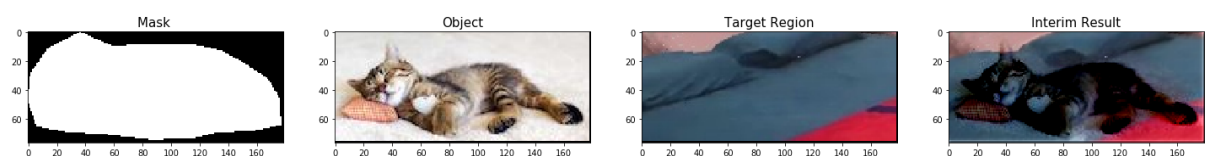


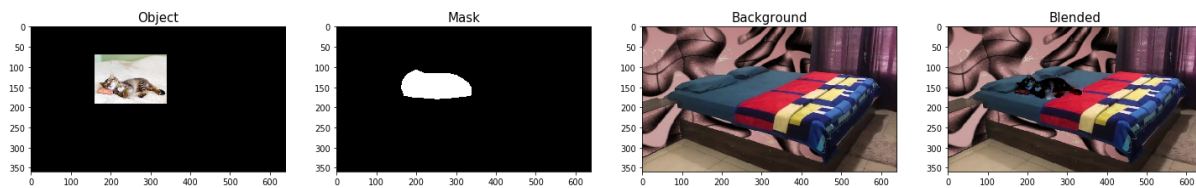
## Result 2

Entire wall + table + side panel



## Result: Cat on bed





## Videos

### Result 1 Video

<https://vimeo.com/416413681>

### Result 2 Video

<https://vimeo.com/416415739>

### Final Result Video

<https://vimeo.com/416415877>

## Project Files

All project files are uploaded on Google Drive

[https://drive.google.com/open?id=1vSAOqsaZq3W5gctakdAbKmxy\\_9Fcf-P](https://drive.google.com/open?id=1vSAOqsaZq3W5gctakdAbKmxy_9Fcf-P)

## Observations

Segmentation techniques give different set of results with every run, even with the same hit points. Hence, it's not possible to reproduce exact same results.

The headboard color and wall color are very similar. Also, the lighting towards the edge of the wall is too bright. Hence, the real corners are hard to find.

Despite the challenges, final results are reasonably good. With a high contrast video, we should expect better results for this implementation.

## References

1. [https://docs.opencv.org/3.4/d8/d83/tutorial\\_py\\_grabcut.html](https://docs.opencv.org/3.4/d8/d83/tutorial_py_grabcut.html)
2. [https://www.bogotobogo.com/python/OpenCV\\_Python/python\\_opencv3\\_Image\\_Segmentation\\_by\\_Foreground\\_Extraction\\_Grabcut\\_Algorithm\\_based\\_on\\_Graph\\_cuts.php](https://www.bogotobogo.com/python/OpenCV_Python/python_opencv3_Image_Segmentation_by_Foreground_Extraction_Grabcut_Algorithm_based_on_Graph_cuts.php)
3. <https://docs.gimp.org/2.10/en/gimp-tool-iscissors.html>

