

A photograph of a hotel room featuring a large bed with white linens and a green blanket. The room has green curtains, a green wall with a small green artwork, and warm lighting from bedside lamps. The text is overlaid on a semi-transparent dark rectangle.

Hotels Against Trafficking

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NO ROOM FOR TRAFFICKING

Motivation



In the United States alone:

- Approximately 75-80% of human trafficking and slavery is for sex
- 30,000 people die each year while being trafficked for sex from neglect, abuse, disease, or torture
- Nearly 20,000 victims are sold and trafficked each year. This number includes the victims who are as young as 5 and 6 years of age
- There have been approximately 100,000 to 150,000 sex slaves since 2001

Source: [The Disturbing Reality of Human Trafficking and Children](#) (Dec 18, 2016)

Objectives

Problem:

- Commercial sex within hotels and motels are most frequently advertised through online platforms (Backpage.com, Eros.com, etc.)

Goal:

- Automatically classifying different hotel chains using Deep Learning



Source: [The National Human Trafficking Hotline](#)

Images

3 hotel chains:

- Two-star hotel chain, Comfort Inn
- Three-star hotel chain, Best Western
- Four-star hotel chain, Hilton



Training set:

- 4,000 (128,128,3) images per hotel chain

Validation set:

- 1,000 (128,128,3) images per hotel chain

Test sets:

- Images are augmented with person-shaped masks of varying size splitted into 4 categories, each contains the same:
 - 388 (128,128,3) Comfort Inn images
 - 384 (128,128,3) Best Western images
 - 249 (128,128,3) Hilton images

Test Sets

Unoccluded



Low Occlusions



Medium Occlusions



High Occlusions



Best Model & Metrics



Best Model:

- VGG-16 Deep Convolutional Neural Network pre-trained on ImageNet database
- Last 5 layers unfrozen to allow for additional training on hotel chain database

Metrics:

- Precision:
 - What proportion of positive identifications was actually correct?
- Recall:
 - What proportion of actual positives was identified correctly?
- **F1-Score:**
 - The harmonic mean of Precision and Recall

F1 SCORE

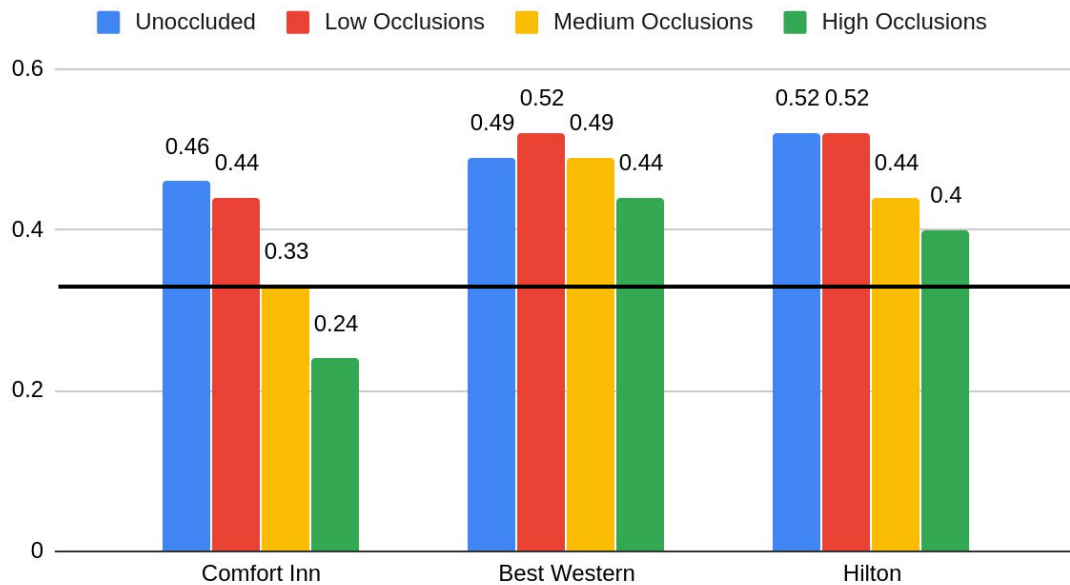
$$F_1 = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

F1 score is the harmonic mean of precision and recall. Values range from 0 (bad) to 1 (good).

Chris Albon

Results

F1-Scores



Difficulties



Comfort Inn

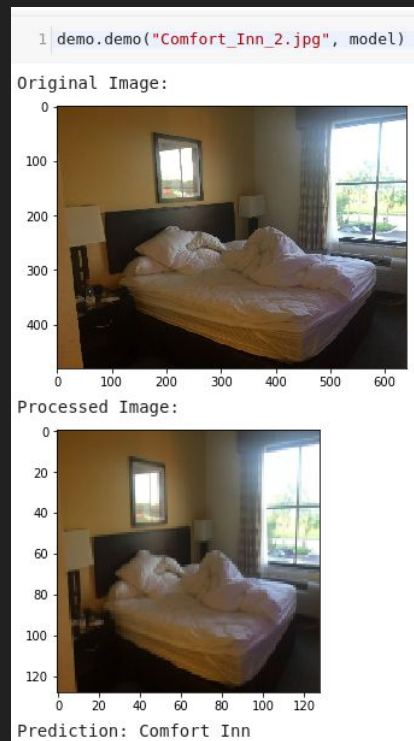
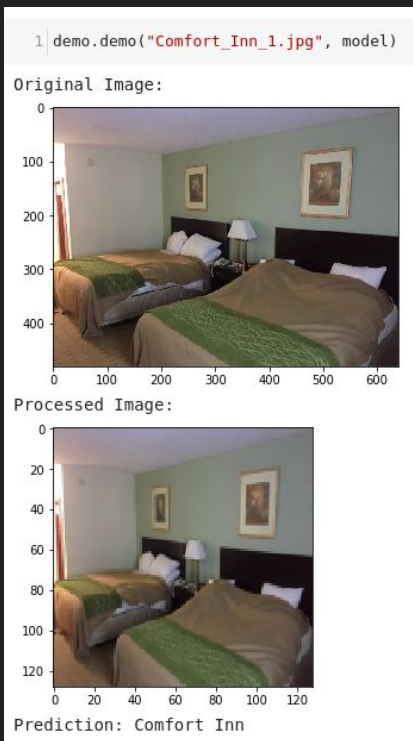


Best Western

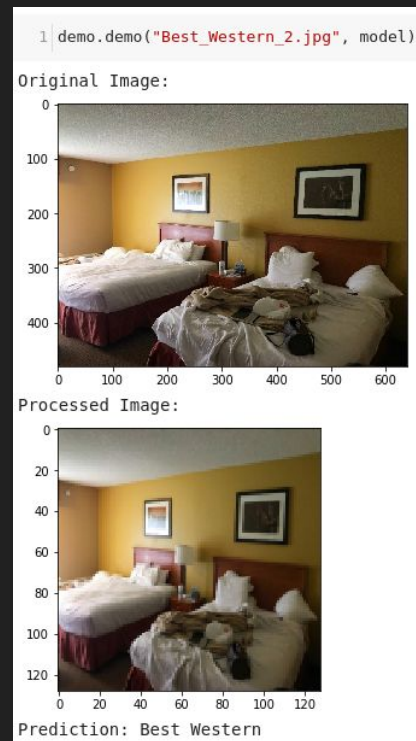
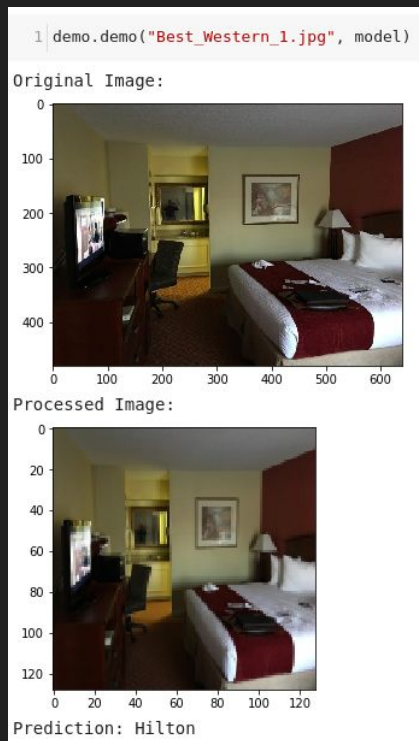


Hilton

Demo - Comfort Inn



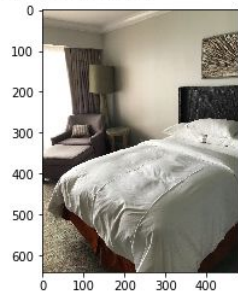
Demo - Best Western



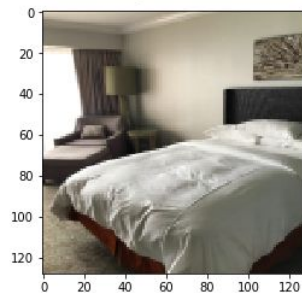
Demo - Hilton

```
1 demo.demo("Hilton_1.jpg", model)
```

Original Image:



Processed Image:



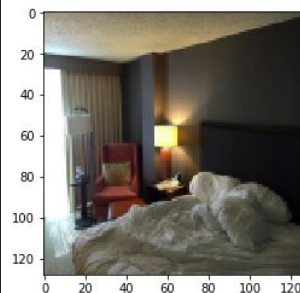
Prediction: Hilton

```
1 demo.demo("Hilton_2.jpg", model)
```

Original Image:



Processed Image:



Prediction: Hilton

Next Steps for Future Improvements

- Further fine-tuning the best model
- Further fine-tuning other Deep Convolutional Neural Network models



Future Plans

- Automatically classifying different hotels and motels using Deep Learning



Questions?

THANK YOU!

Sources

- <https://keras.io/models/sequential/>
- <https://keras.io/applications/>
- <https://keras.io/callbacks/>
- <https://keras.io/layers/core/>
- <https://keras.io/layers/normalization/>
- <https://keras.io/utils/>
- https://scikit-learn.org/stable/modules/generated/sklearn.model_selection.train_test_split.html
- https://scikit-learn.org/stable/modules/model_evaluation.html#classification-metrics
- <https://pypi.org/project/opencv-python/>

Contact Information

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