Identifying Near Identical Images using Deep Learning

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Introduction

Near-Identical Images are images whose visual context is essential the same. Although easy for humans to identify they are extremely difficult for computers. This study shows the results of using a convolutional neural network in conjunction with a nearest neighbor algorithm against the classical methods.

Near Identical Image Example

Original Image

Near Identical Image
(Change in Temporal State)

Aim

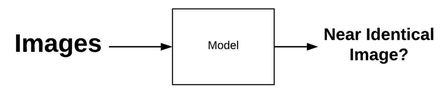
- Identify near identical duplicate images
- Create a new pipeline that uses:
  - Pre-Trained Convolutional Neural Network
  - Nearest Neighbor Algorithm
- Compare results with classical methods
- Compare Pre-Trained Networks

Databases

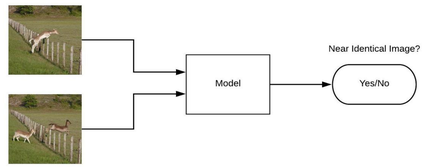
- Holidays (1491 Images & 500 Groups)
- UKBench (10200 Images & 2550 Groups)

Method

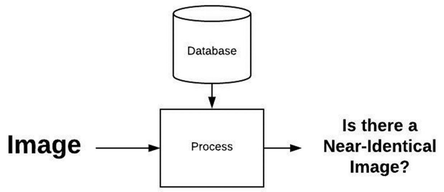
Highest Abstract Lebel



Physical Representation

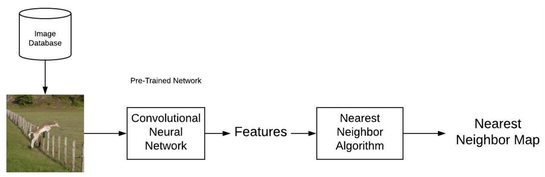


System Representation To Test Model

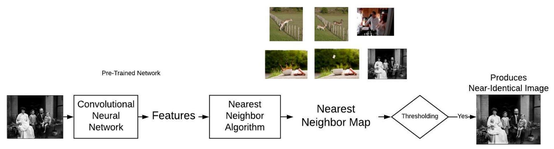


Two Step Procedure

1) Train the Network and Map All Images



2) Test Images for Nearest Neighbour

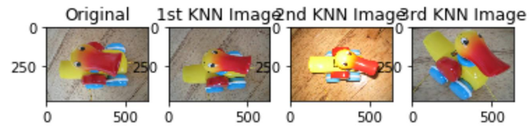


Results

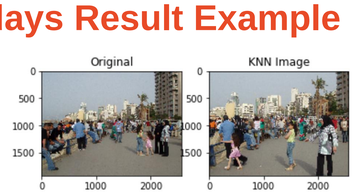
Comparison of Results		
Methods	Holidays(mAP)	UKBench
SIFT-BoW	59.7 %	2.85
SIFT-Soft	-	3.17
VLAD	51.0 %	3.15
VLAD+SSR	55.7 %	3.35
Fisher	56.5 %	3.33
Doube Channel Network	61.2 %	3.29
Pulse Neural Network	96.7%	-
Ours	99.0 %	3.92

Holidays result are from 100%.
UKBench results are from 4.0.

UKBench Result Example



Holidays Result Example



Comparison of Pre-Trained Networks

Model	Accuracy on ImageNet	Accuracy on UKBench	Total Time (s)
VGG16	0.90	3.82	575
VGG19	0.90	3.82	482
ResNet50	0.92	3.89	829
densenet121	0.92	3.90	1782
densenet169	0.93	3.91	2319
densenet201	0.94	3.93	2700
NasNetMobile	0.92	3.49	2769
MobileNet	0.90	3.90	388
InceptionResNetV2	0.95	3.52	5032

Accuracy on ImageNet represents the accepted rating of the model. Used as a benchmarks to measure the performance of the model.

Conclusions

- Model is much more accurate than any of the previous classical methods
- Model is much more accurate than the previous published methods that utilize Deep Learning
- Densenet201 provided the highest accuracy but took 2699 seconds for training.
- MobileNet provided a high degree of accuracy in a short amount of time making it the ideal and most efficient pre-trained network for recognizing near-identical images.

Citations

- Y. Zhang, Y. Zhang, J. Sun, H. Li, and Y. Zhu, “Learning Near Duplicate Image Pairs using Convolutional Neural Networks.,” Int. J. Performability Eng., vol. 14, no. 1, 2018.
- G. Yona, “Fast Near-Duplicate Image Search using Locality Sensitive Hashing,” Medium. F. Nian, T. Li, X. Wu, Q. Gao, and F. Li, “Efficient near-duplicate image detection with a local-based binary representation,” Multimed. Tools Appl., vol. 75, no. 5, pp. 2435–2452, 2016.

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