

Introduction to Computer Vision

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Senior Member, IEEE – Member, ACM

<https://sander-ali.github.io>

Computer Vision & Image Processing



- Experience
 - Assistant Professor at Department of Telecommunication Engineering, UoS.
 - Postdoctoral Research from Tech University of Korea, South Korea.
 - Lecturer, Department of Telecommunication Engineering, UoS.
 - Network Engineer, New Horizon IT Ltd.
 - System Support Engineering, Comstar ISA Ltd.
- Education
 - Ph.D. in Industrial and Information Systems Engineering, Hankuk University of Foreign Studies, South Korea.
 - Masters in Communication Systems and Network Engineering, MUET, Pakistan.
 - Bachelors in Telecommunication Engineering, MUET, Pakistan.



Outline

- Course Logistics
- What is Computer Vision?
- Computer Vision Applications
- Course Logistics



Course Logistics

- How to reach me:
 - Sandar.ali@usindh.edu.pk
 - <https://sander-ali.github.io>
- Google Classroom
 - Class code (IT/EL): inqhlyz / gqhipmo
 - Class link IT <https://classroom.google.com/c/NTgzNjEzMTExODk0?cjc=inqhlyz>
 - Class link EL <https://classroom.google.com/c/NTgzNjEzMjY0Mjc1?cjc=gqhipmo>
- Lectures are **not** compulsory – but meant to be useful.
- **YOU DON'T LEARN TO DO JUST BY LISTENING**
- Distribution of marks, under discussion

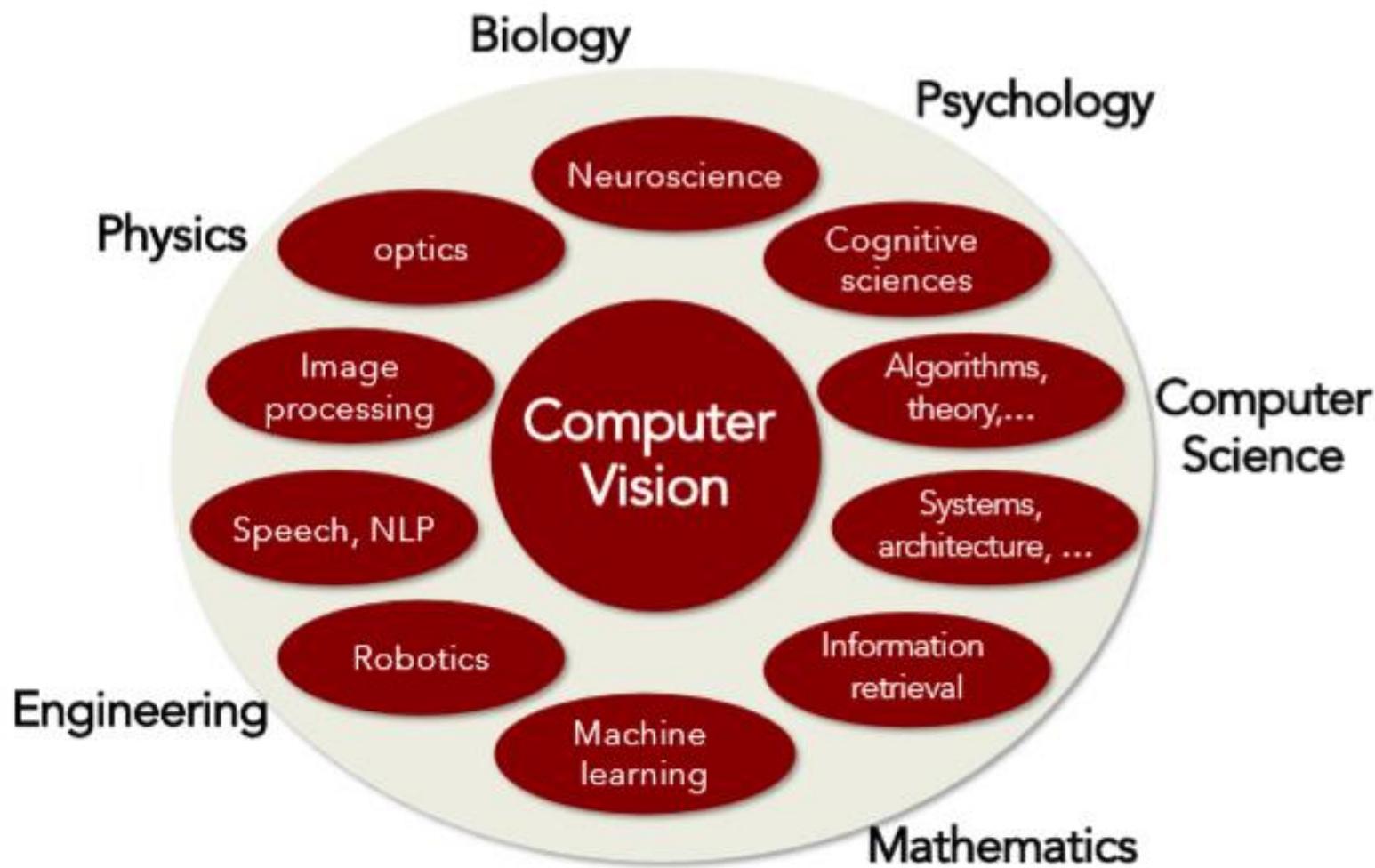


Pre-requisite

- Programming skills
 - I will not teach you how to code, sorry for that
 - Language is your choice but I would recommend Python/MATLAB
- Some knowledge on
 - Calculus
 - Linear Algebra
 - Probability and Statistics
- If you're missing some of these, I will provide some pointers to help.



Spectrum of Computer Vision

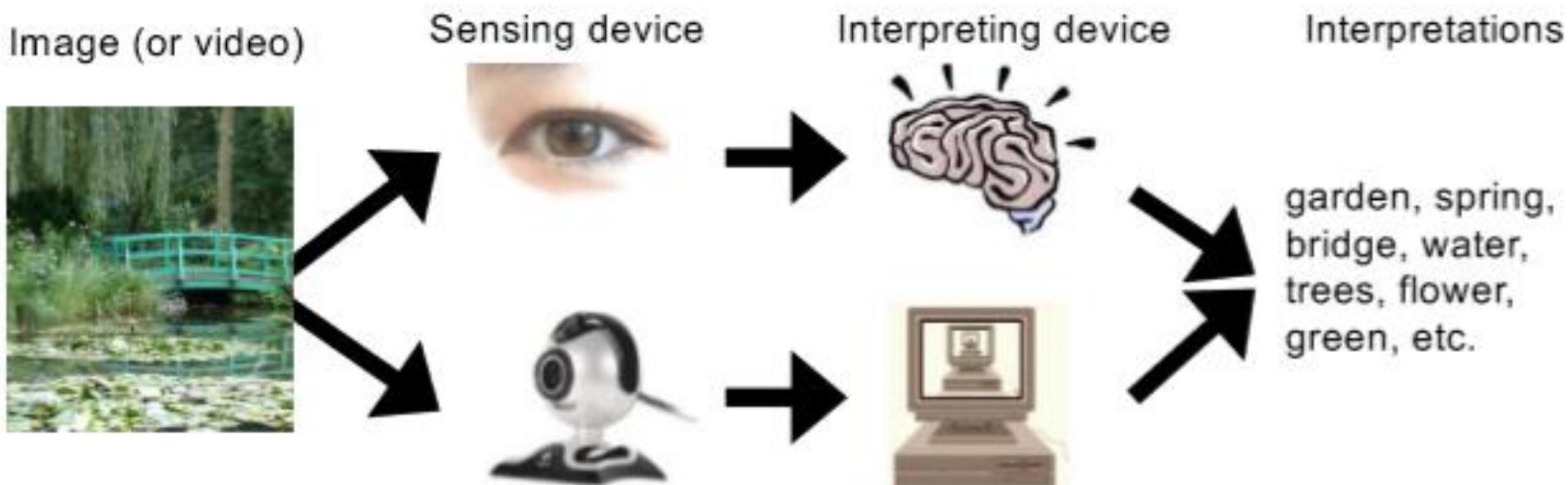


Computer Vision and Nearby Fields

- Computer Graphics: Models to Images
- Comp. Photography: Images to Images
- Computer Vision: Images to Models



What is Computer Vision?



What is Computer Vision?



Photo by Svetlana Lazebnik

What a person sees

What is Computer Vision?

What a computer sees

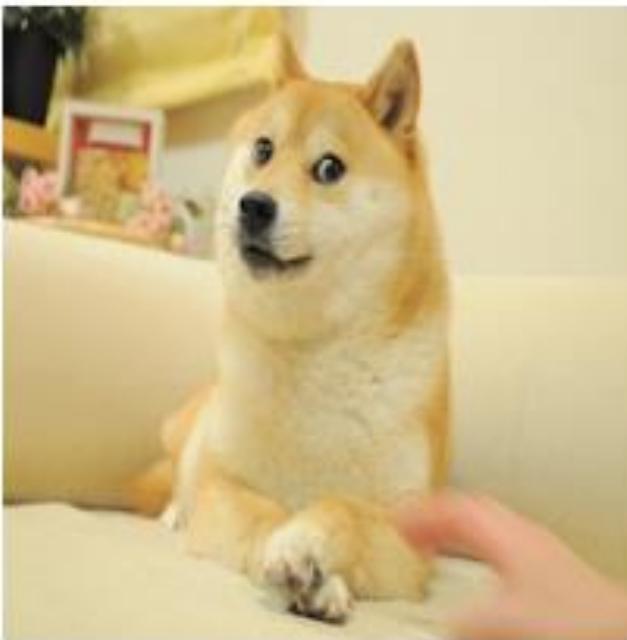
What is Computer Vision?



Photo by Svetlana Lazebnik

Why are we able to interpret this image?

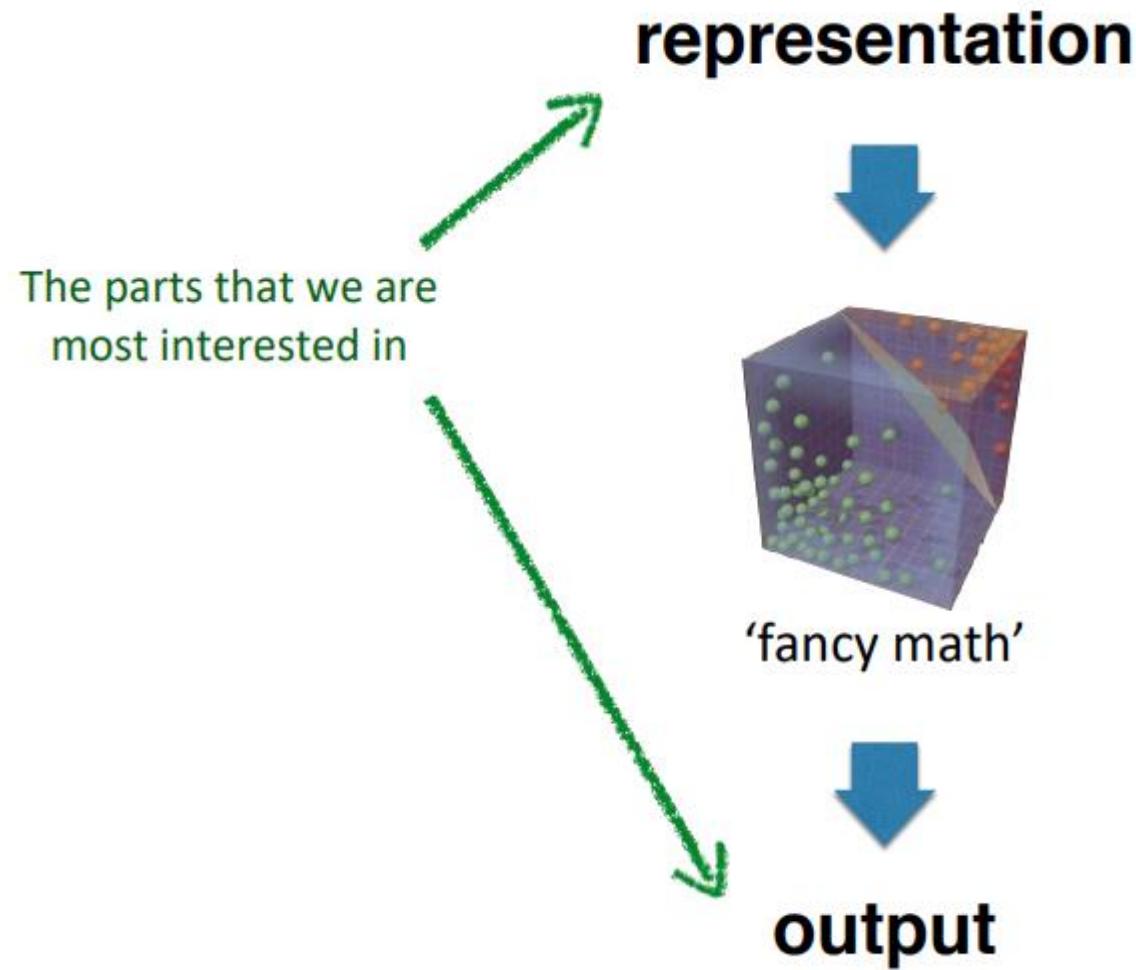
To bridge the gap between pixels and “meaning”



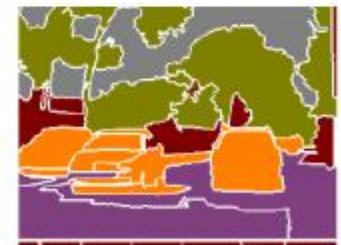
Blue channel			Green channel			Red channel		
	1	2	3	4	...	64		
1	120	67	89	107	...	13	18	39
2	12	216	145	26	...	181	81	71
3	0	16	4	45	...	44	56	...
4	0	78	90	167	...	25	...	7
...	12	...
64	12	67	82	141	...	12		

Image array: [64 x 64 x 3]

Typical Perception Pipeline



what should we look at?
(image features)



what can we understand?
(semantic segmentation)

Important Note:

In general, Computer Vision does not work

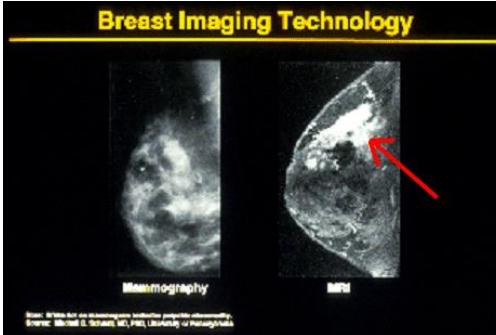
Except in certain situations/conditions



Why Computer Vision Matters



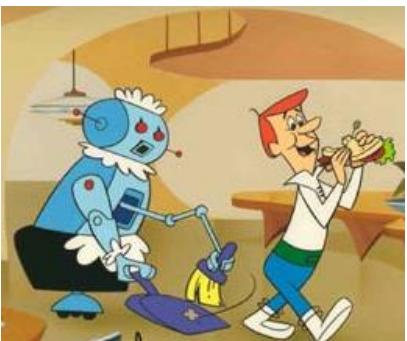
Safety



Health



Security



Comfort



Fun

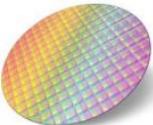


Access



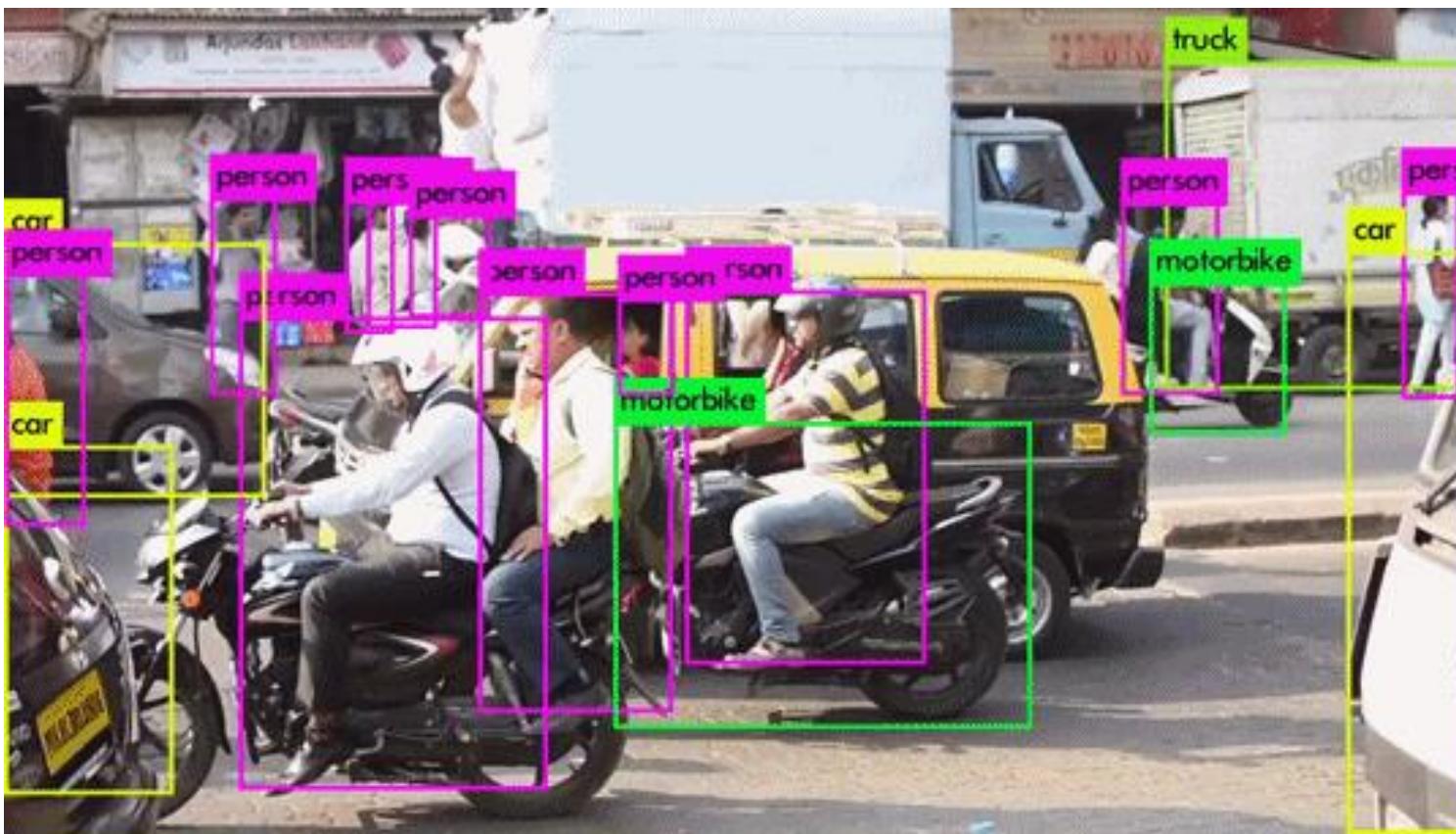
Applications of Computer Vision

- Automated Visual inspection

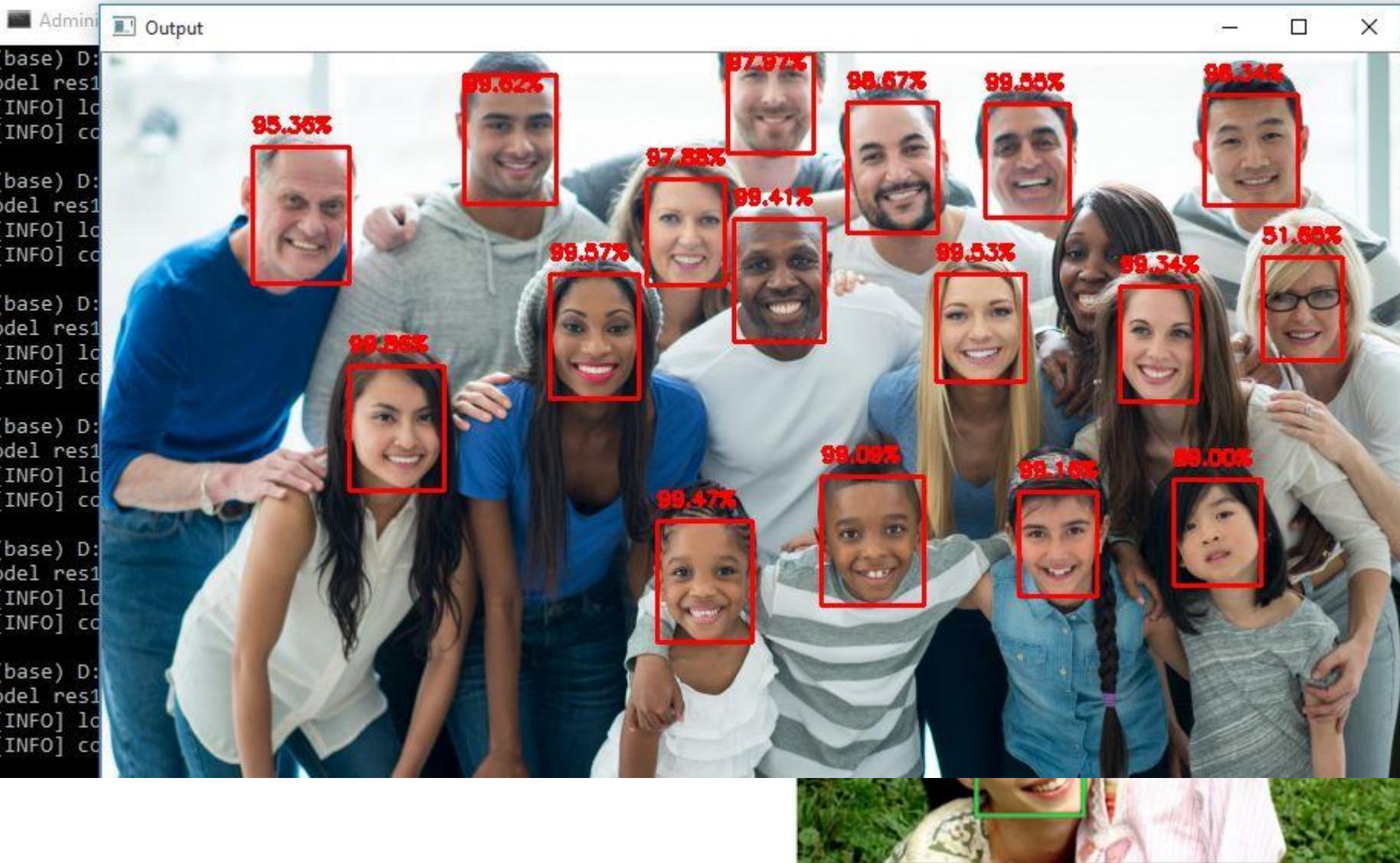


Applications of Computer Vision

- Object Recognition



Applications of Computer Vision



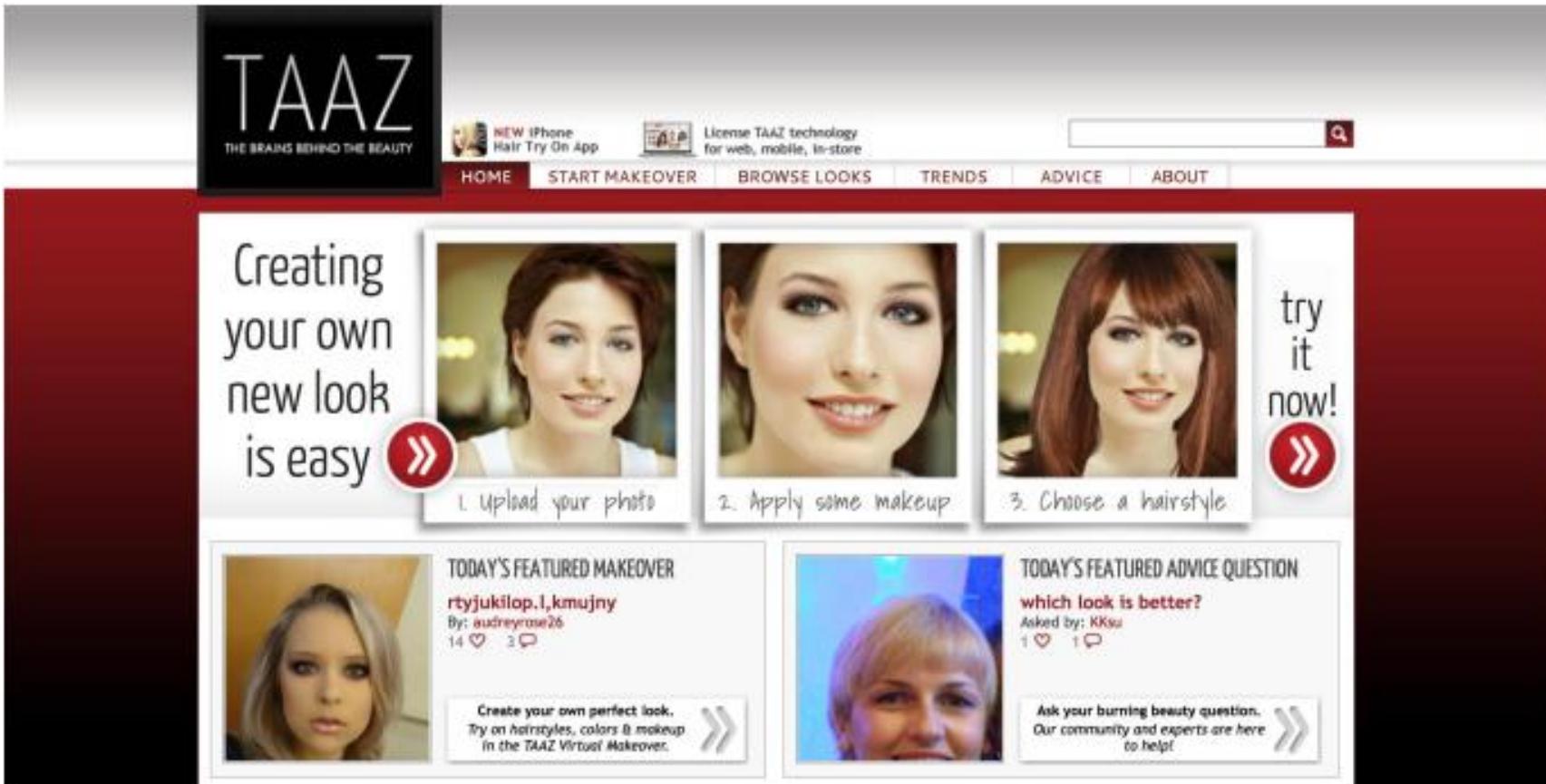
Smile recognition

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Applications of Computer Vision

- Face Makeovers



Applications of Computer Vision



Input Image



AnimeGANv2
(FacePaint Style)



AnimeGANv2
(CelebDistill Style)



AnimeGANv3
(Arcane Style)



AnimeGANv3
(Disney Style)



Toonify Classic



DualStyleGAN



White-Box Cartoon
Representation



Resolution Dependent
GAN



Face-PAST
(Cartoon Style)

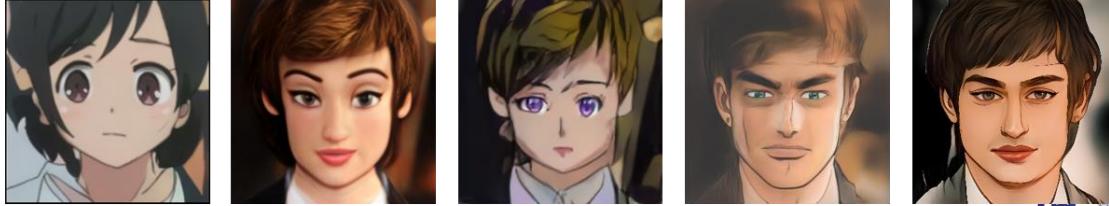
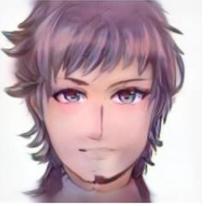
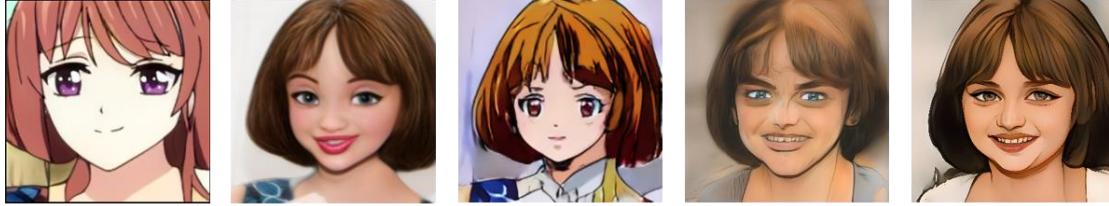


Face-PAST
(Arcane Style)



Face-PAST
(Disney Style)

Applications of Computer Vision



Input Image
w/ Example

DualStyleGAN

UI2I-style

StarGANv2

GNR

Toonify

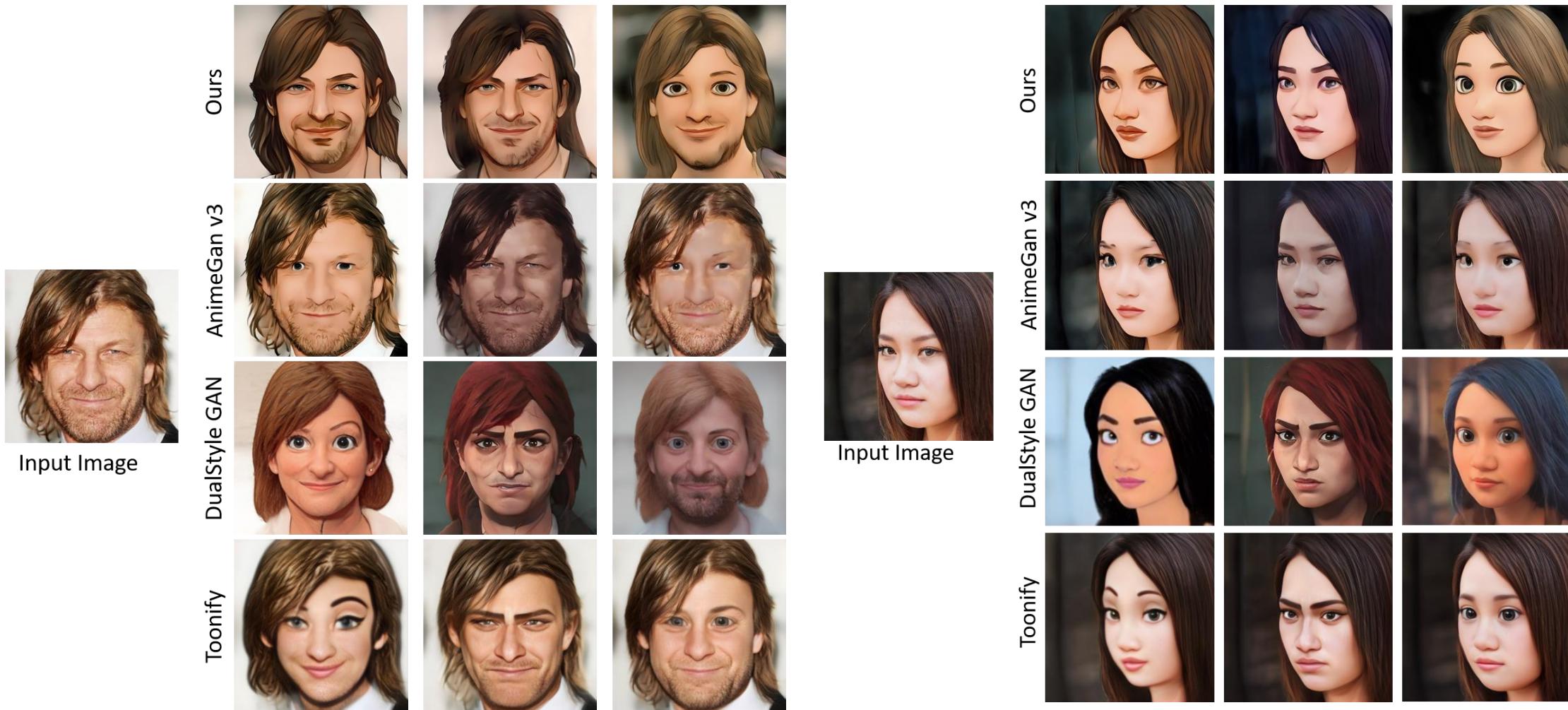
U-GAT-IT

JoJoGAN

Ours



Applications of Computer Vision



Applications of Computer Vision



Applications of Computer Vision



BMW night visi



The system converts image data taken by 4 super-wide angle cameras, to display a virtual image of the vehicle from above.

ew" camera



Image stitching



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Applications of Computer Vision

Original image



3D reconstruct 1



3D reconstruct 2



3D reconstruct 3



Original image



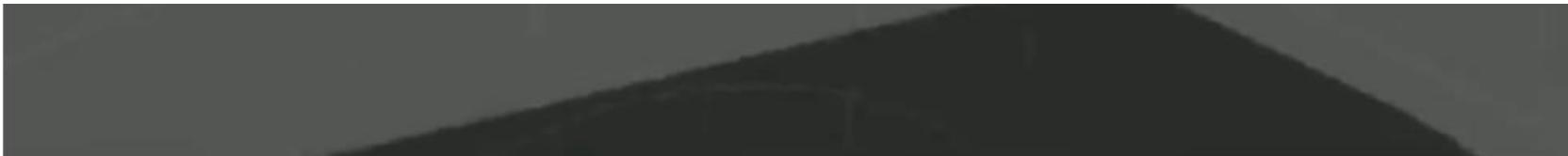
3D reconstruct 1



3D reconstruct 2



3D reconstruct 3



Applications of Computer Vision

- Virtual Fitting



Computer Vision for VR

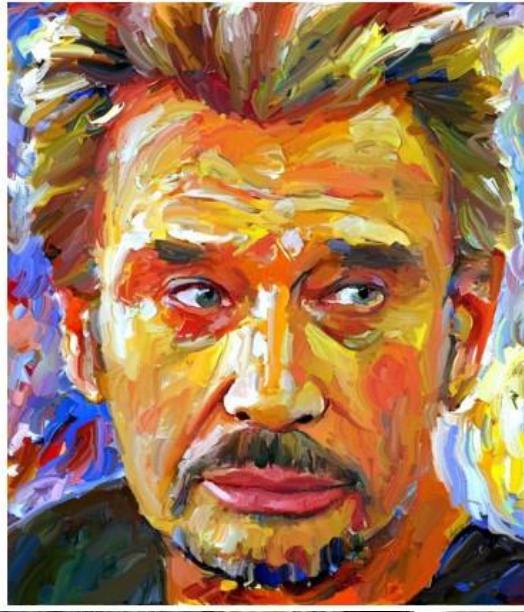


Applications of Computer Vision

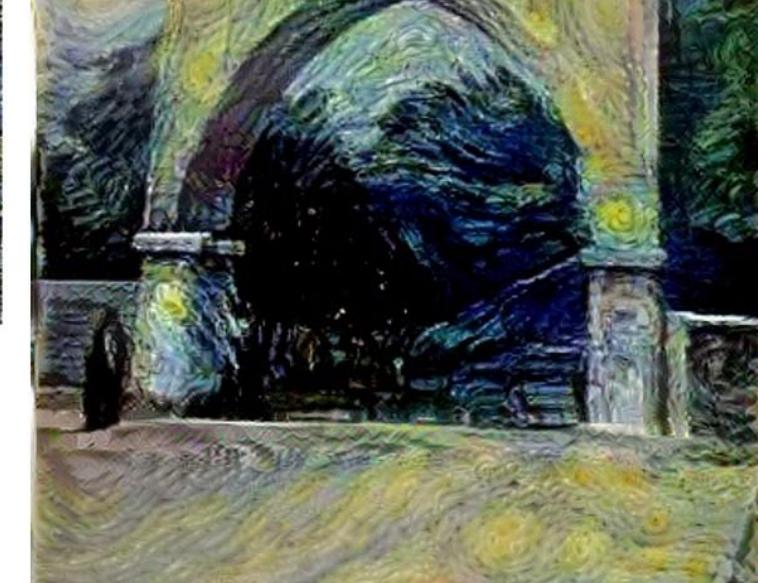
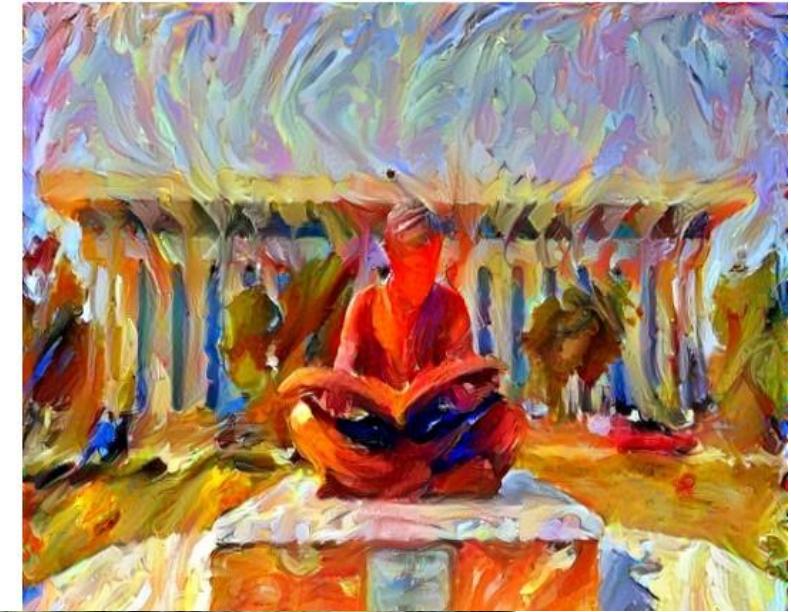
Original



Style Image

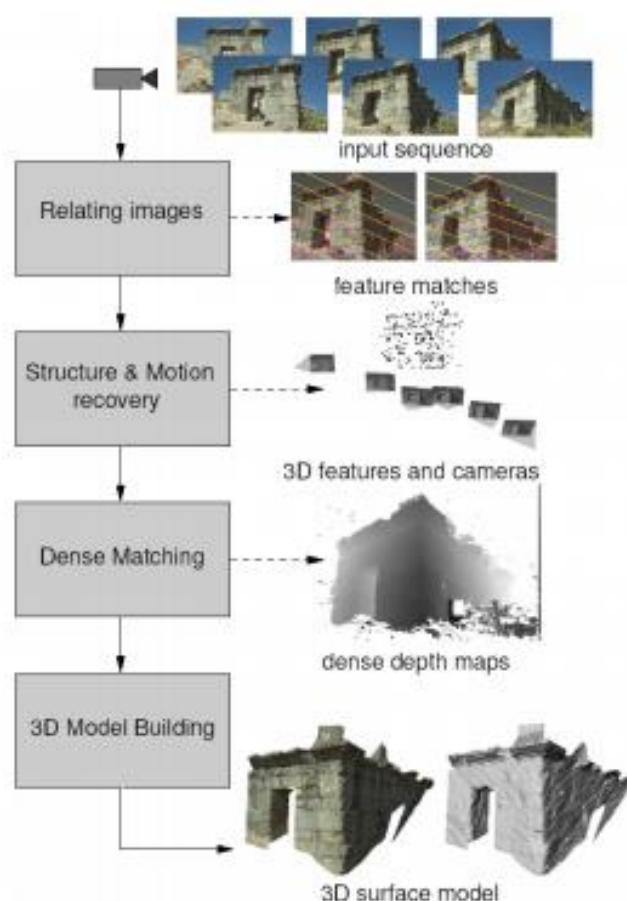


Style Transferred Image



Applications of Computer Vision

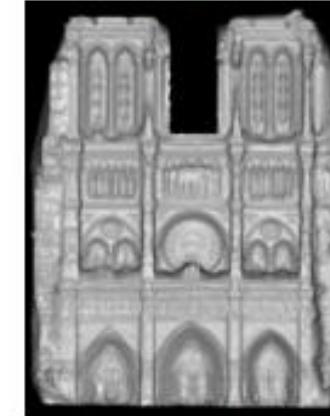
- Vision as a measurement device



Pollefeys et al.

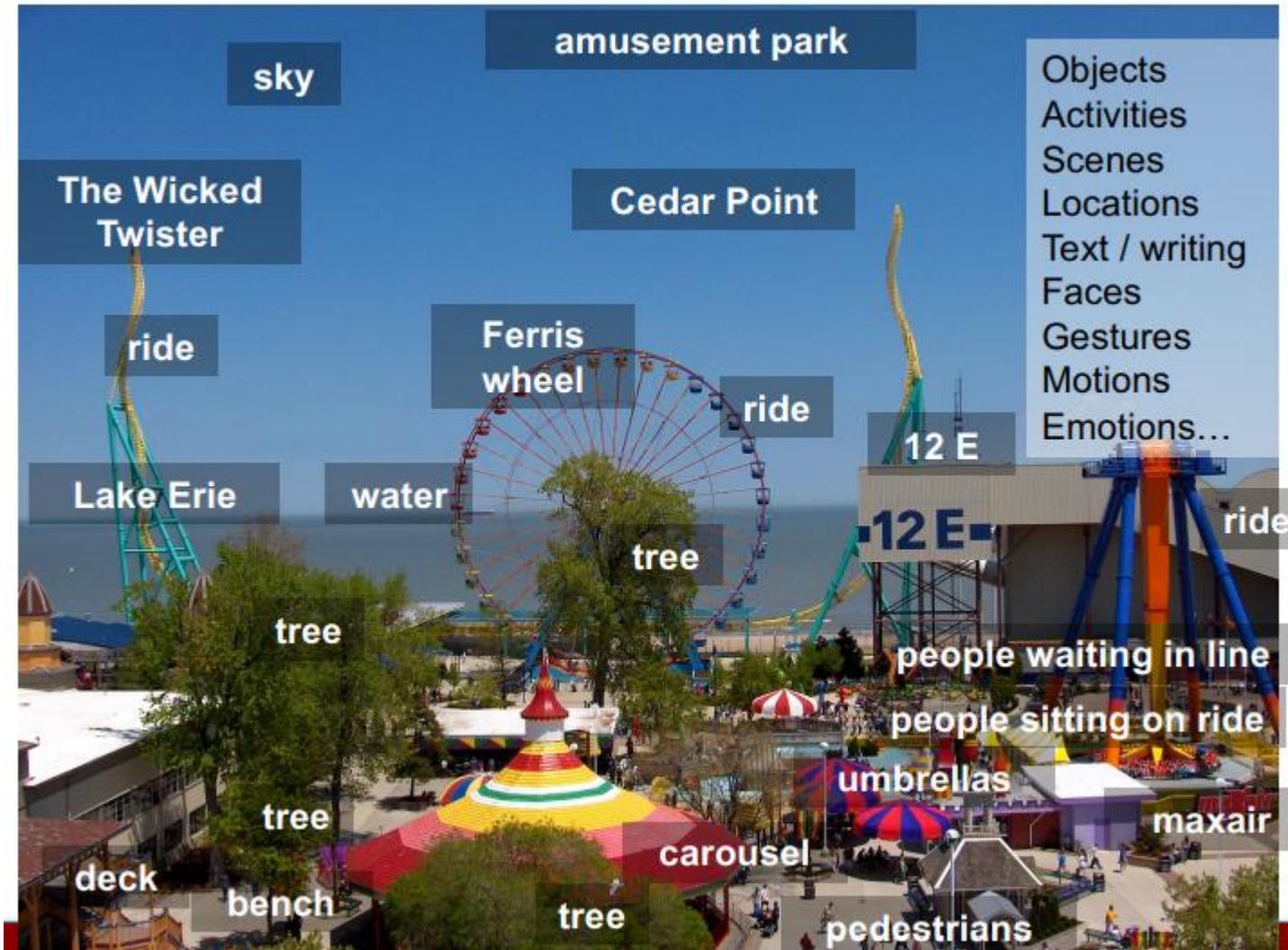


Goesele et al.



Applications of Computer Vision

- Semantic Information



Applications of Computer Vision



PLACE TAGS	PROBABIL	PROBABILITY
lecture room	47.36%	65.17%
classroom	38.82%	26.47%
computer room	3.77%	1.55%
legislative chamber	2.68%	1.12%
conference room	2.12%	1.04%
conference center	1.97%	1.02%
office cubicles	0.69%	0.63%



Applications of Computer Vision

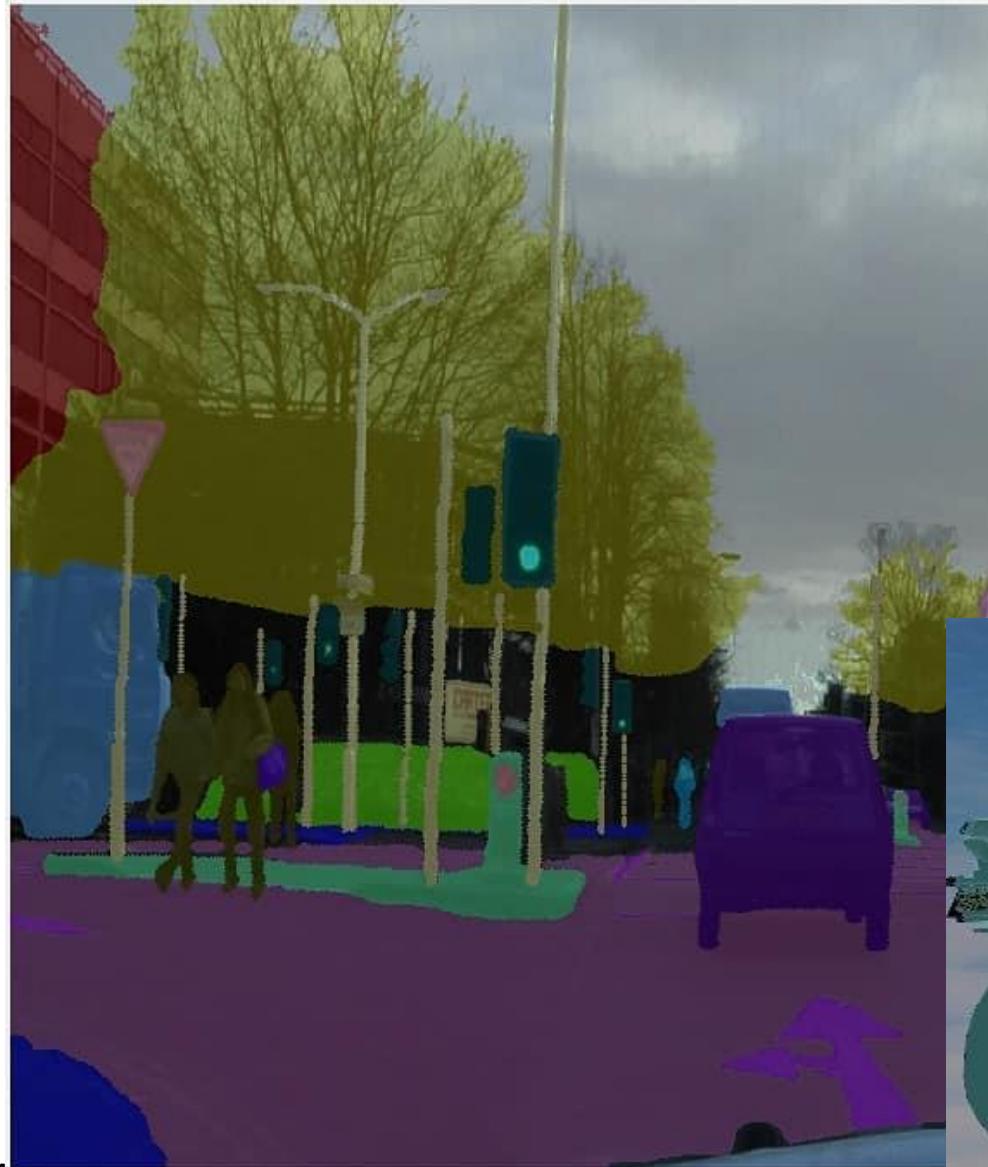


ORIGINAL IMAGE



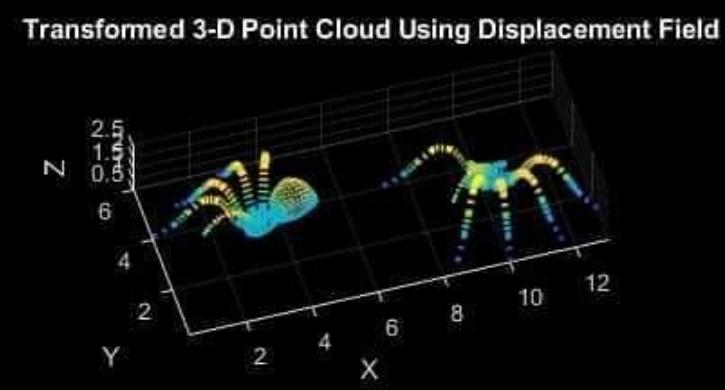
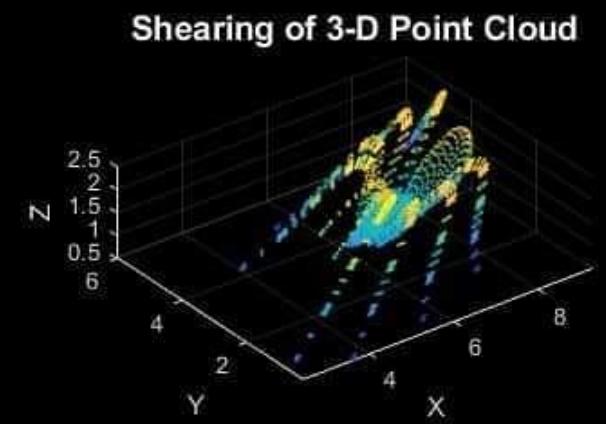
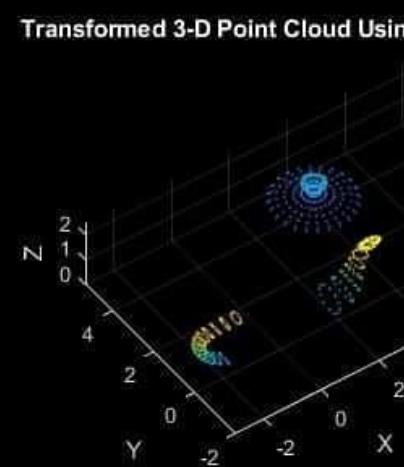
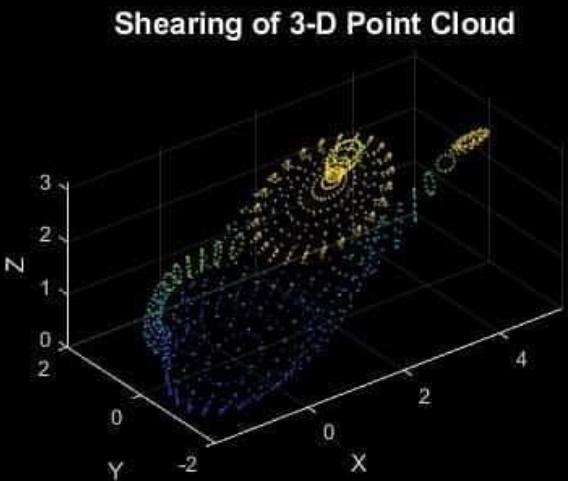
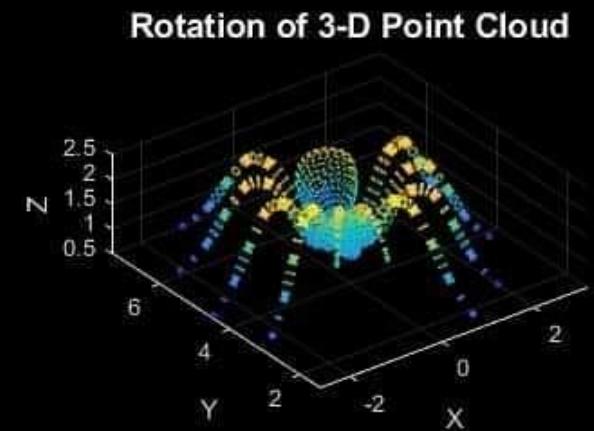
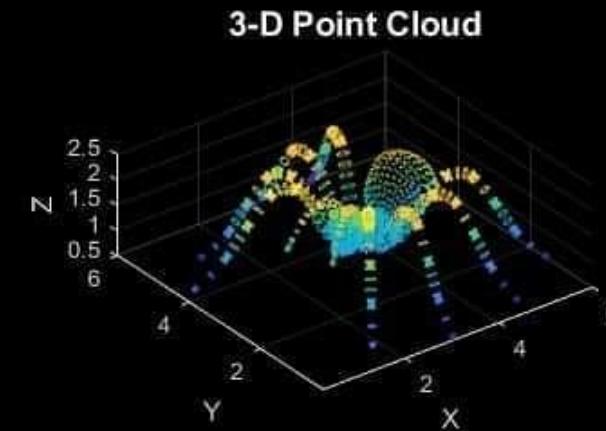
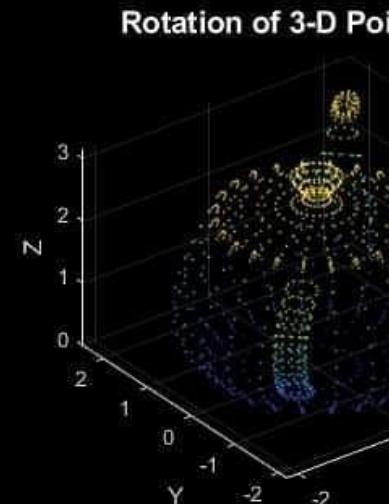
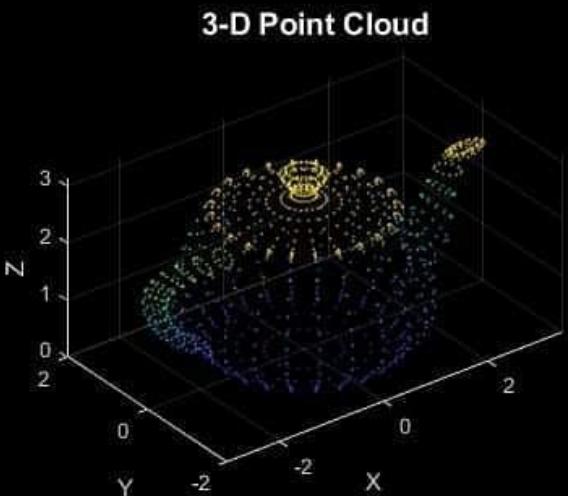
INPAINTED RESULT

Applications of Computer Vision



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Applications of Computer Vision



Other Applications

- Action Recognition
- Image Denoising
- Image Stitching
- Image Blending
- Image Inpainting
- Medical Imaging
- Geo Imaging
- Self-Driving Cars
- Computer Games
- Social Robots
- Special Effects
- OCR
- Biometrics
- Augmented and Virtual Reality



Why Study Computer Vision

- Images and videos are everywhere



Google
Image Search

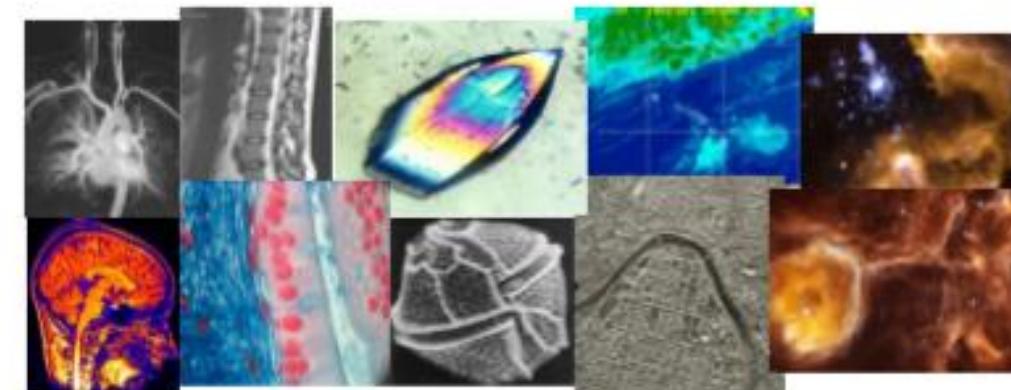
Google Photos

flickr

webshots

picsearch

YouTube
Broadcast Yourself!



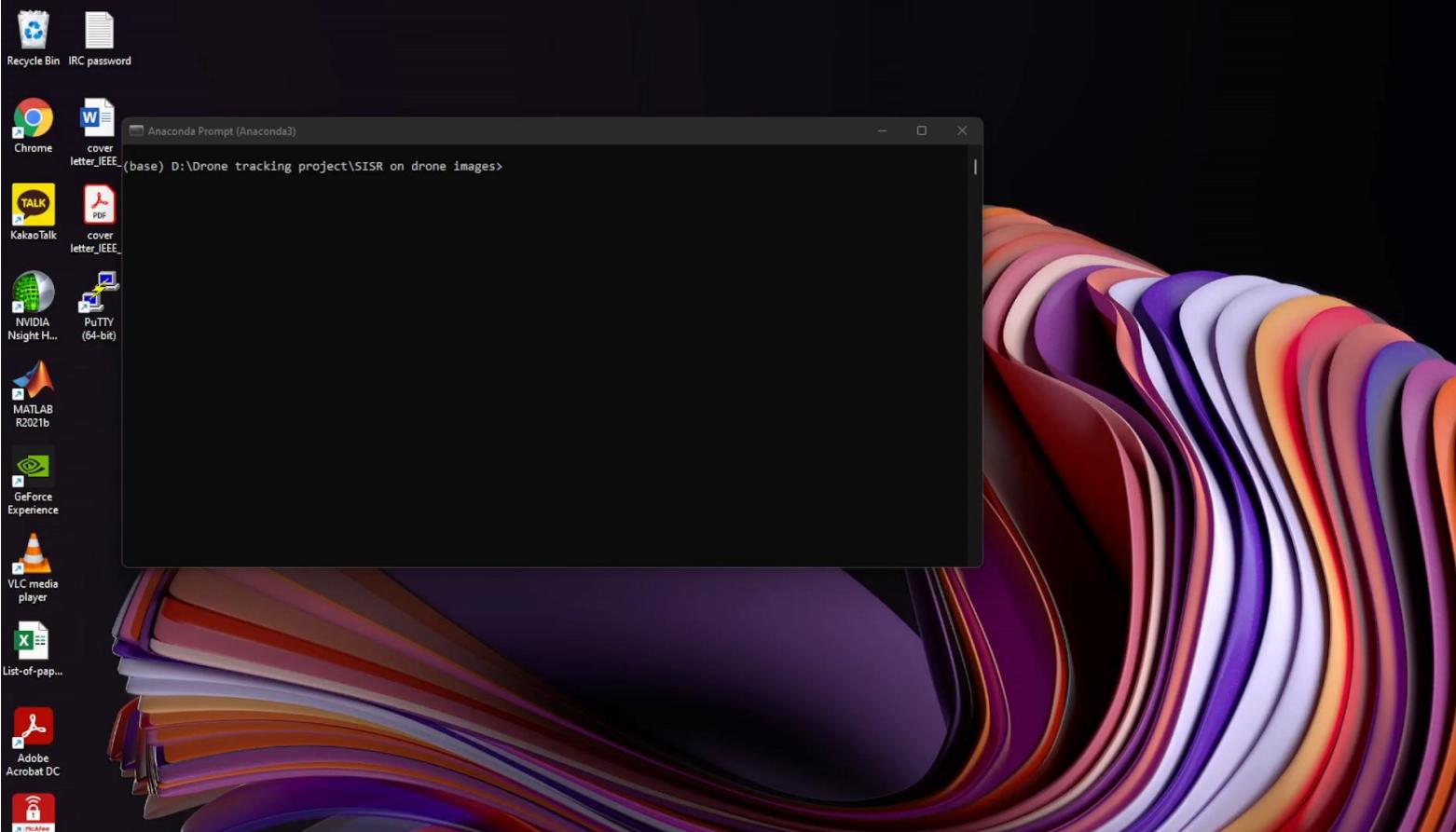
Use cases



[Bing maps](#), Google Streetview

Ongoing Works

- Drone Aiming



Ongoing Works

- Avatar Generation



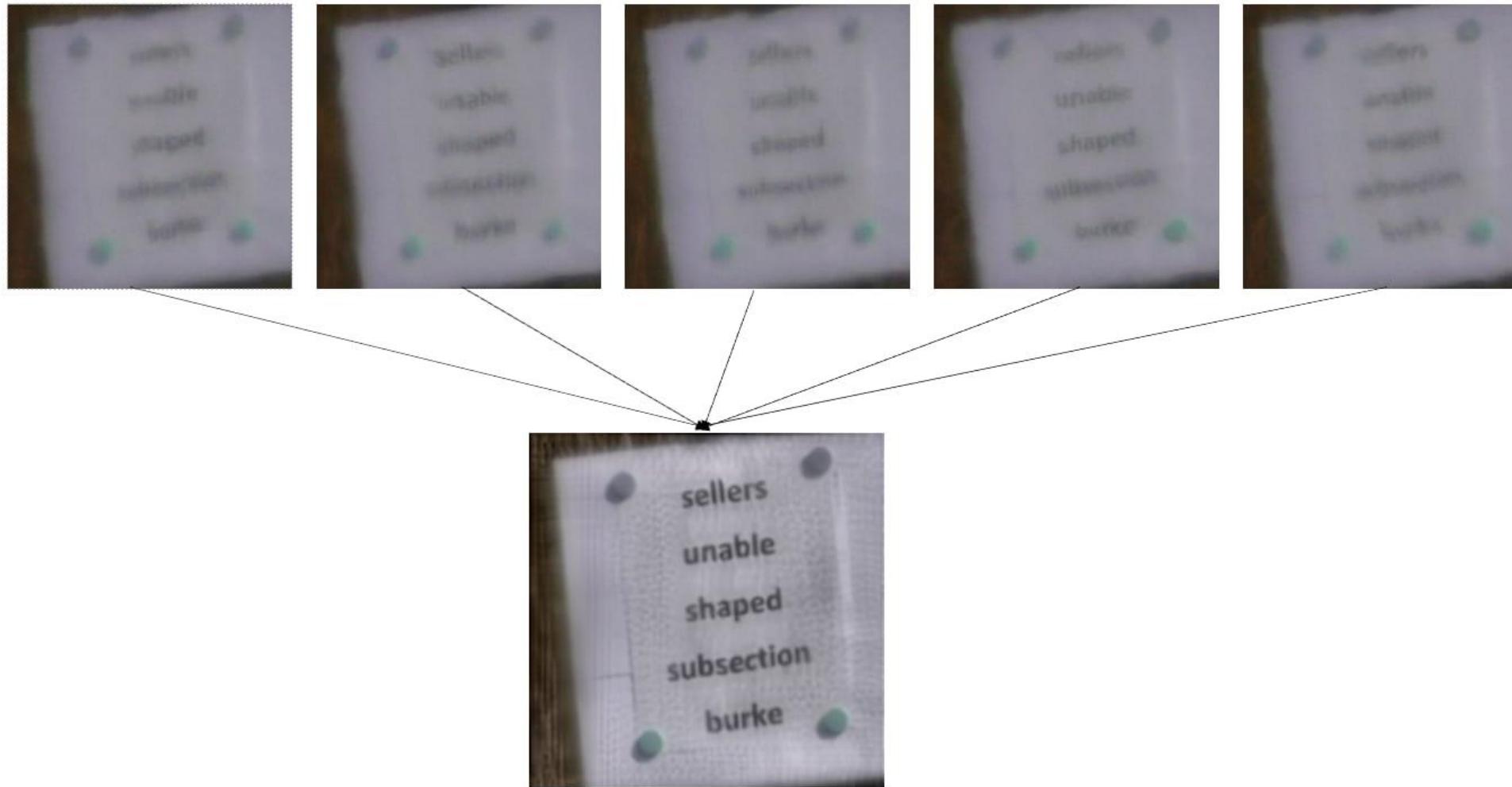
- Art Generation From Text



CVPR Competitions 2022



CVPR Competitions 2022



Demos

More demos are available at
<https://github.com/sander-ali>



Why Study Computer Vision



Industry aggressively hiring
CV graduates, or even
students!

(strong dominant industrial presence at
conferences for recruitment)

//cvpr2022.thecvf.com/jobs

facebook research Research Areas Publications People Programs Downloads Careers Blog Q

JULY 21, 2017

Advancing computer vision technologies at CVPR 2017

By: Facebook Research

Google Research Blog The latest news from Research at Google

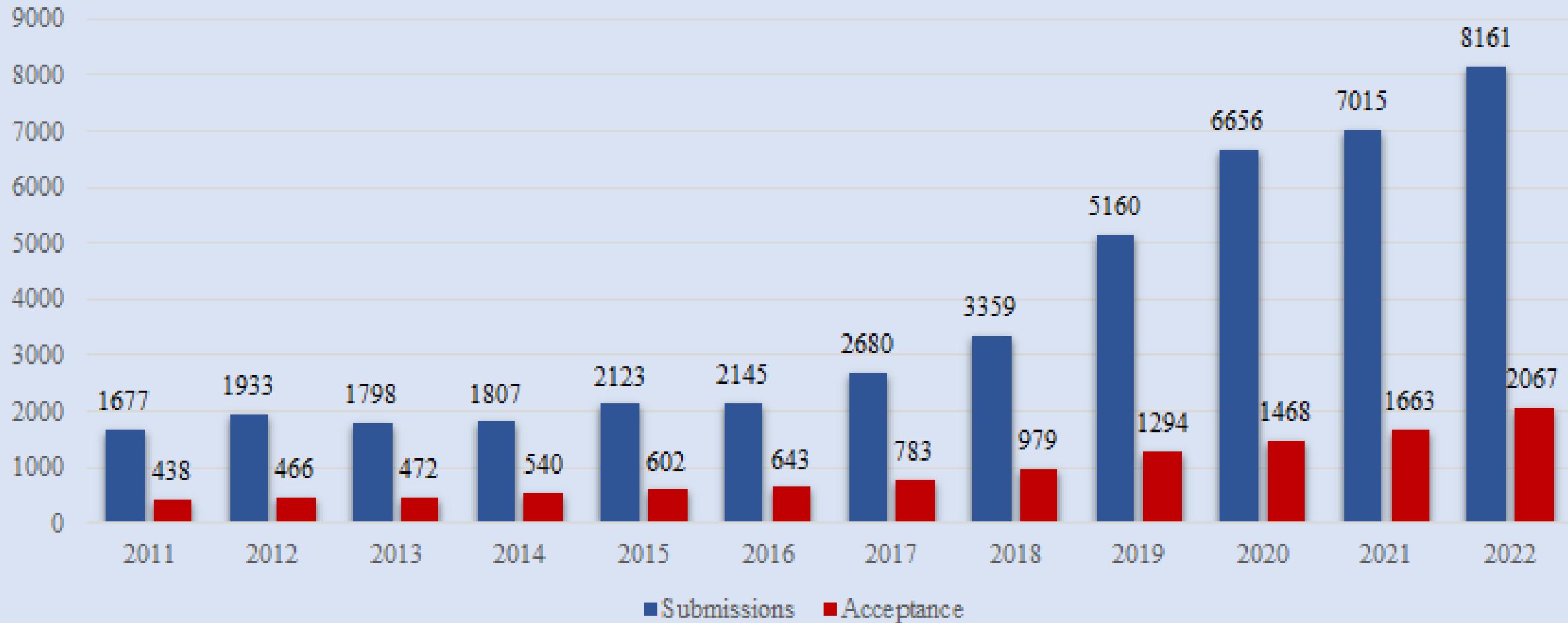
Microsoft Research @ CVPR 2017

Google at CVPR 2017 Friday, July 21, 2017

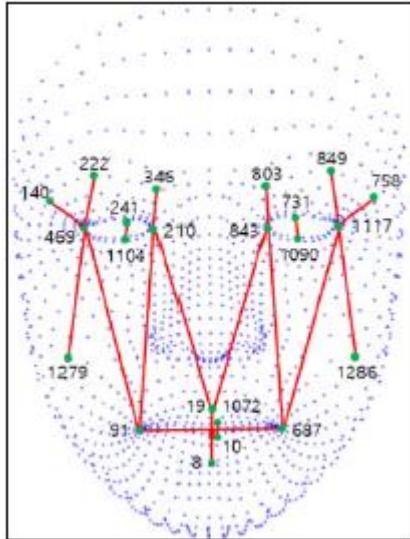
0 \$180,000



CVPR Acceptance Rate



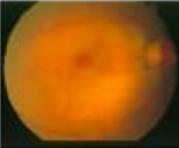
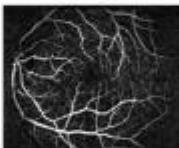
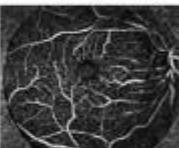
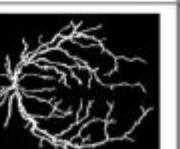
My Published Research Works



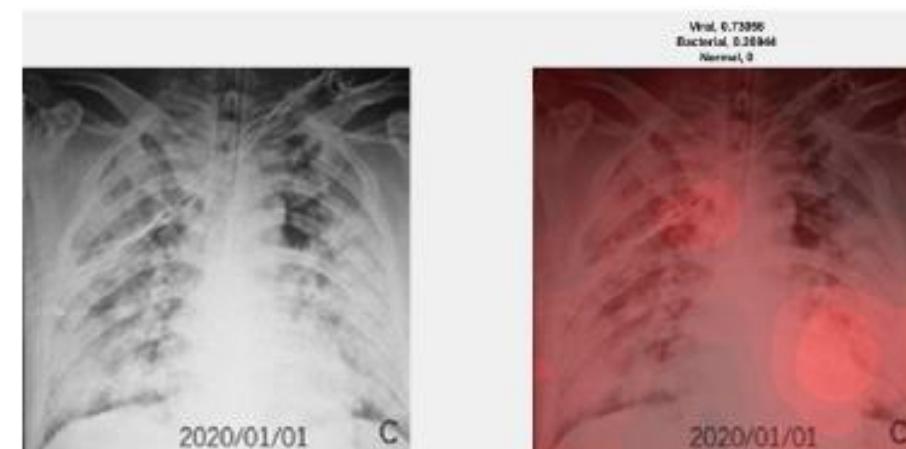
Fine-grained emotion recognition: fusion of physiological signals and facial expressions on spontaneous emotion corpus, International Journal of Adhoc and Ubiquitous Computing, 2020



Semantic Image Networks for Human Action Recognition
International Journal of Computer Vision 2019.

	Best Case Accuracy	Worst Case Accuracy		Best Case Accuracy	Worst Case Accuracy
Original Image			Original Image		
Enhanced Image			Enhanced Image		
Segmented Image			Segmented Image		

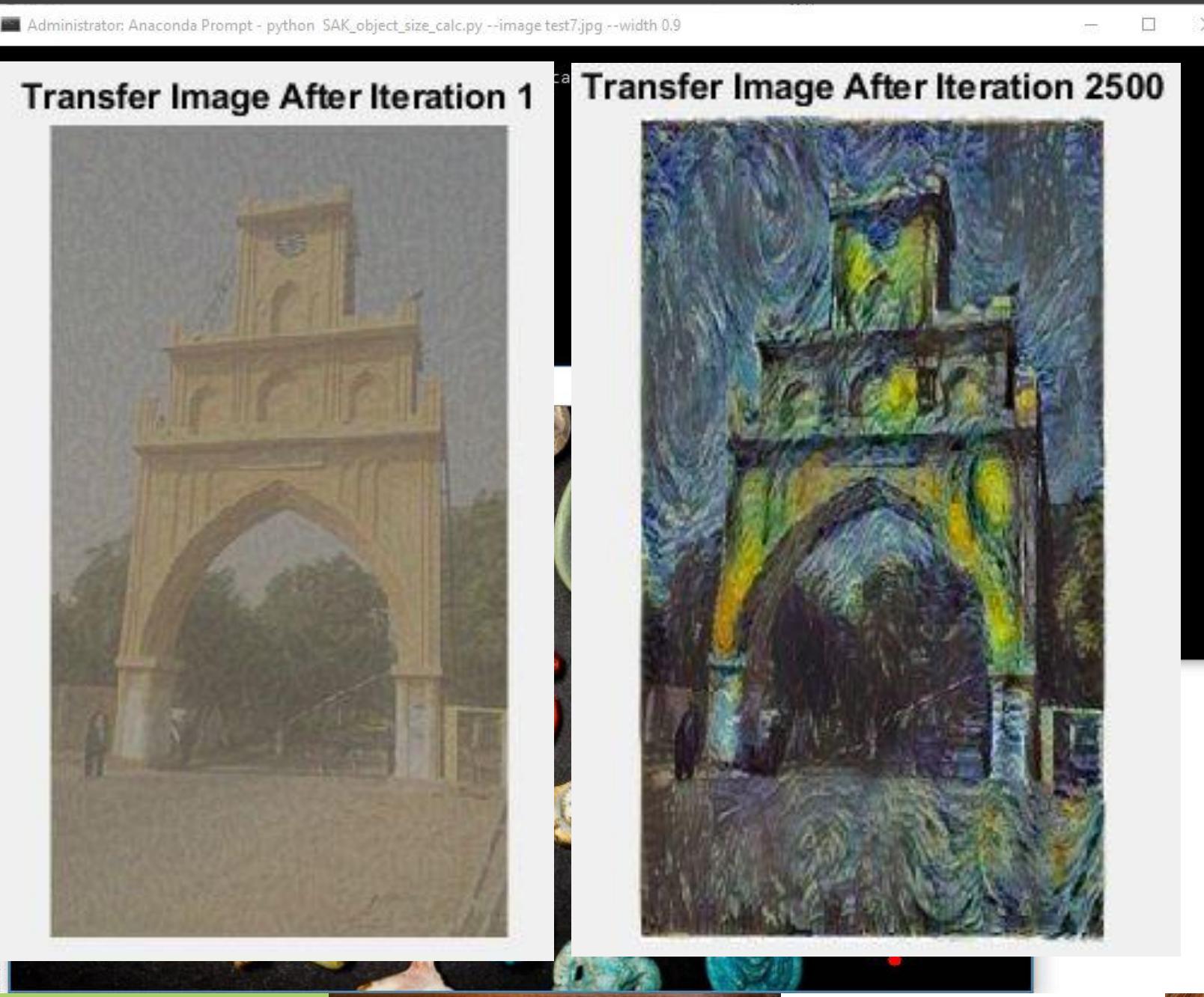
A framework for retinal vessel segmentation from fundus images using hybrid feature set and hierarchical classification, Signal, Image, and Video Processing, 2019



Triage of potential COVID-19 patients from chest X-ray images using hierarchical convolutional networks, Neural Computing and Applications 2021



Sor



108 108 108]

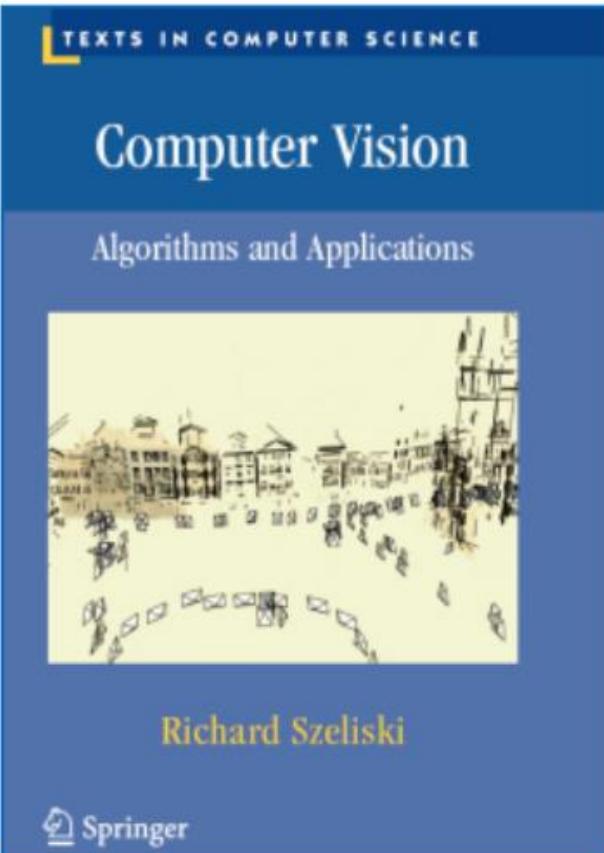
rogram of the Image



Character



Book



PDF online

<http://szeliski.org/Book/>

Multiple View Geometry in Computer Vision by Richard Hartley and Andrew Zisserman

Computer Vision: a modern approach by Forsyth and Pence
Digital Image processing by Gonzales and Woods

Further Reading through research papers

Will assign or mention them whenever needed