



INTRODUCTION TO MACHINE LEARNING

For Computer Animation and Game

17 September 2019

INTRODUCTION TO MACHINE LEARNING

For Computer Animation and Game

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ภาควิชาเทคโนโลยีสารสนเทศ

Multi-agent Intelligent Simulation Laboratory (MISL)

• Research Area

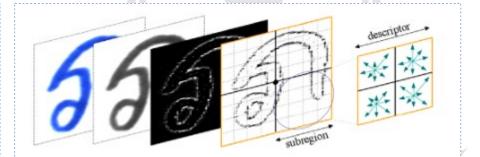
Image Processing, Computer Vision, Machine Learning Pattern Recognition, Object Detection, Deep Learning Historical Document Analysis



Historical Document



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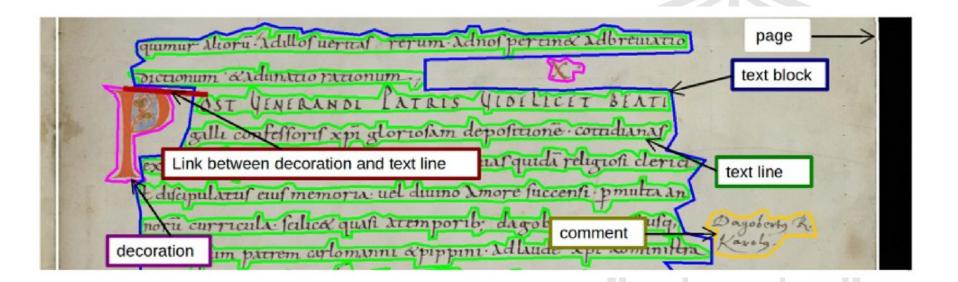
Local Gradient Feature Descriptor

Historical Document Analysis

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Historical Document Layout Analysis Competition

Historical Document Layout Analysis

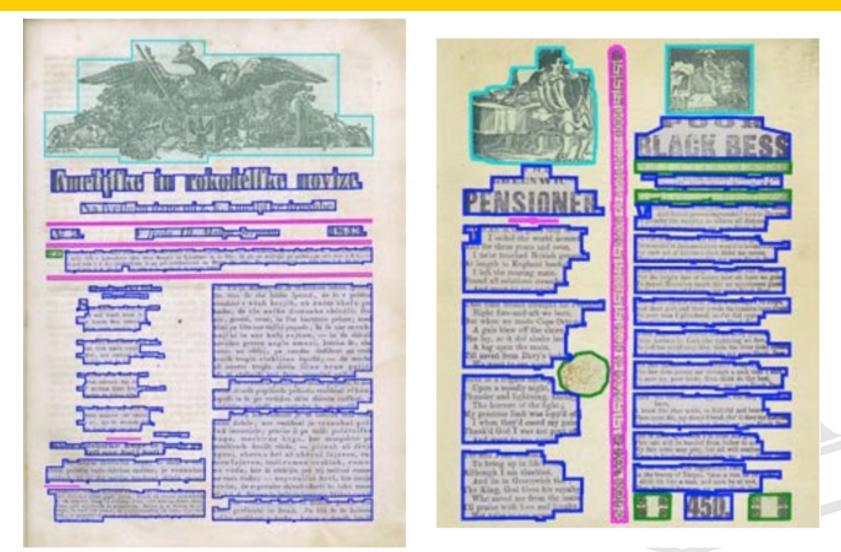




Ground truth model, tool, and dataset for layout analysis of historical documents

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Historical Document Layout Analysis



Historical Document Layout Analysis Competition

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Ground truth model, tool, and dataset for layout analysis of historical documents

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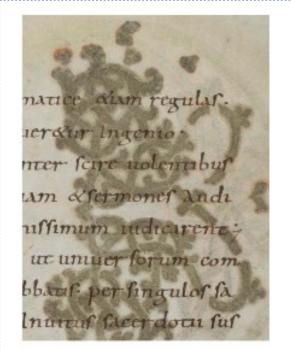
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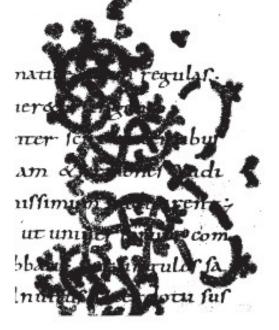
Layout Analysis of Handwritten Historical Documents for Searching the Archive of the Cabinet of the Dutch Queen



Layout Analysis of Handwritten Historical Documents for Searching the Archive of the Cabinet of the Dutch Queen

Binarization technique





Otsu's algorithm

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Sauvola's algorithm

A* Path Planning for Line Segmentation of Handwritten Documents

A* Path Planning Algorithm

$$p^* = \arg\min_{p^a} \sum_{i=1}^{n^a-1} C(s^a_i, s^a_{i+1})$$

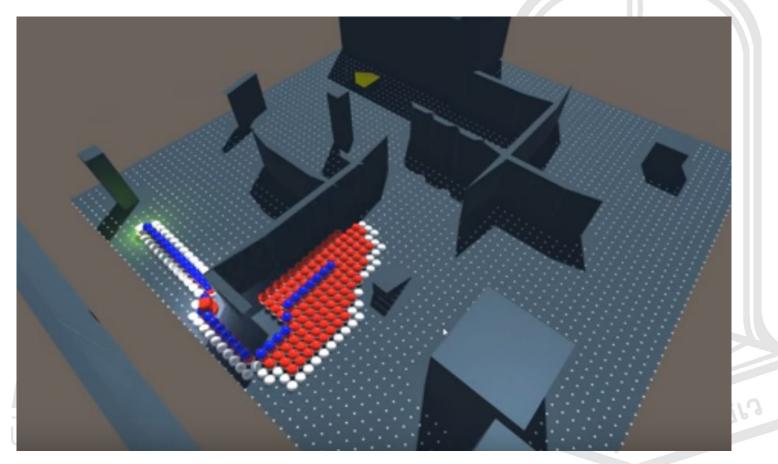
where $C(s_i, s_j)$ is the cost to go from state s_i to state s_j .

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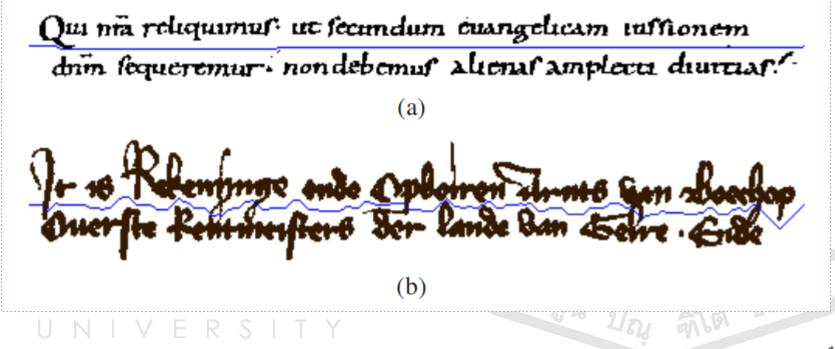
A* Path Planning for Line Segmentation of Handwritten Documents

Unity3D – A* Pathfinding algorithm

https://www.youtube.com/watch?v=Ny63E6iLkpc



$$C(s_i, s_j) = c_d D(s_i) + c_{d2} D(s_i)^2 + c_m M(s_i) + c_v V(s_i) + c_n N(s_i, s_j)$$



A* Path Planning for Line Segmentation of Handwritten Documents

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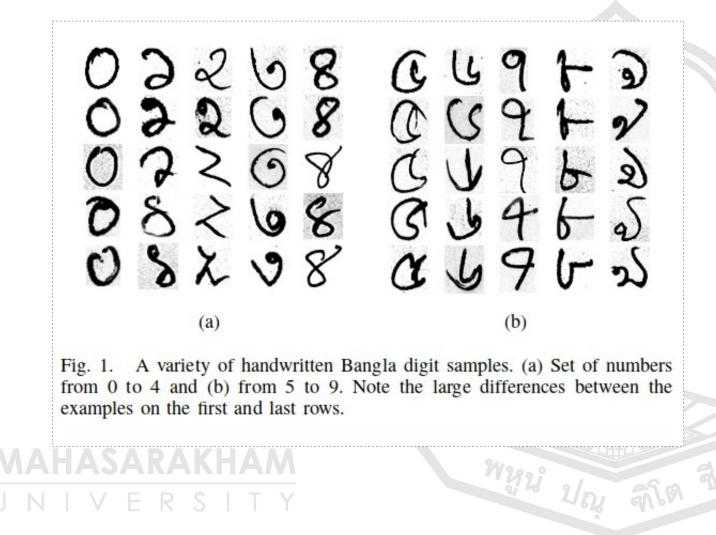
A* Path Planning for Line Segmentation of Handwritten Documents

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A* Path Planning for Line Segmentation of Handwritten Documents

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A* Path Planning for Line Segmentation of Handwritten Documents



A Comparison of Feature and Pixel-based Methods for Recognizing Handwritten Bangla Digits

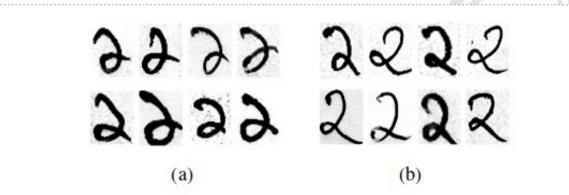


Fig. 2. Similarities between different handwritten Bangla digits. (a) The images of number 1, and (b) number 2.

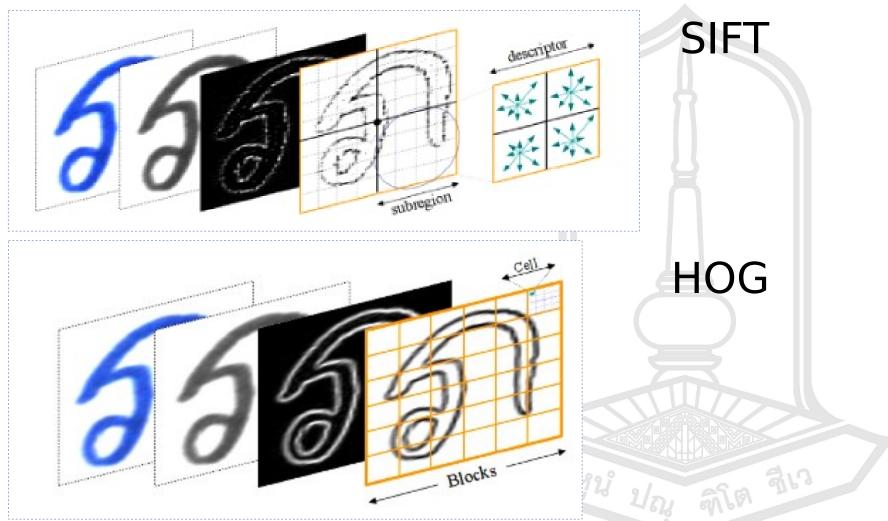


A Comparison of Feature and Pixel-based Methods for Recognizing Handwritten Bangla Digits

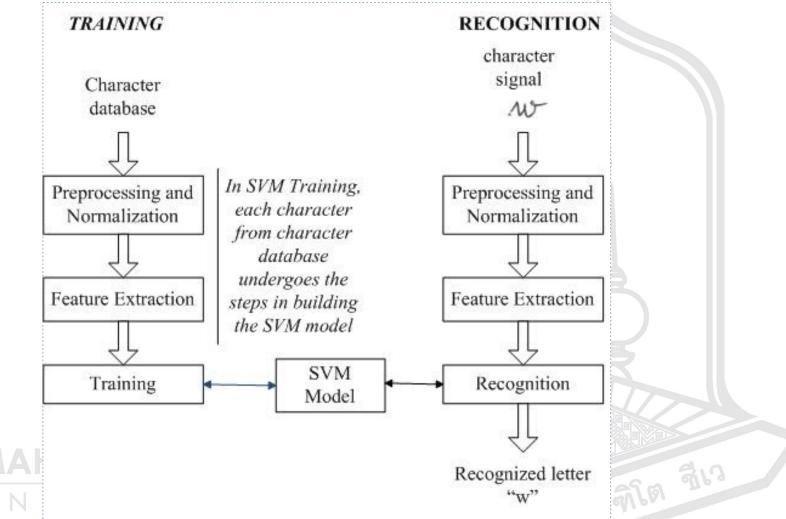
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https://www.learnopencv.com/handwritten-digits-classification-an-opencv-c-python-tutorial/

Feature Extraction Techniques

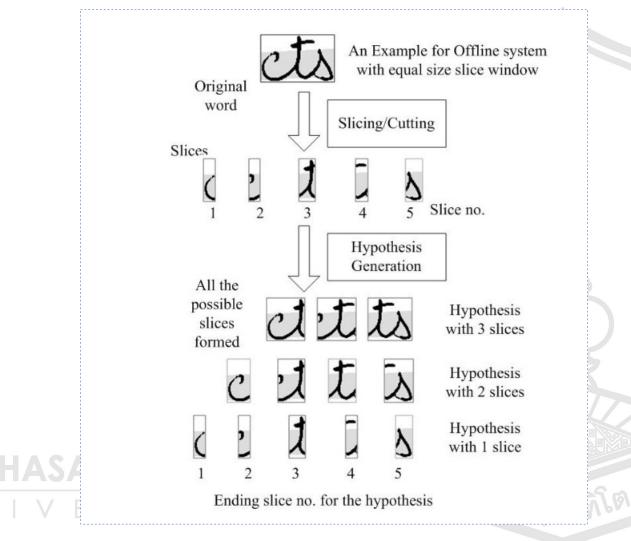


Recognition of Handwritten Characters using Local Gradient Feature Descriptors



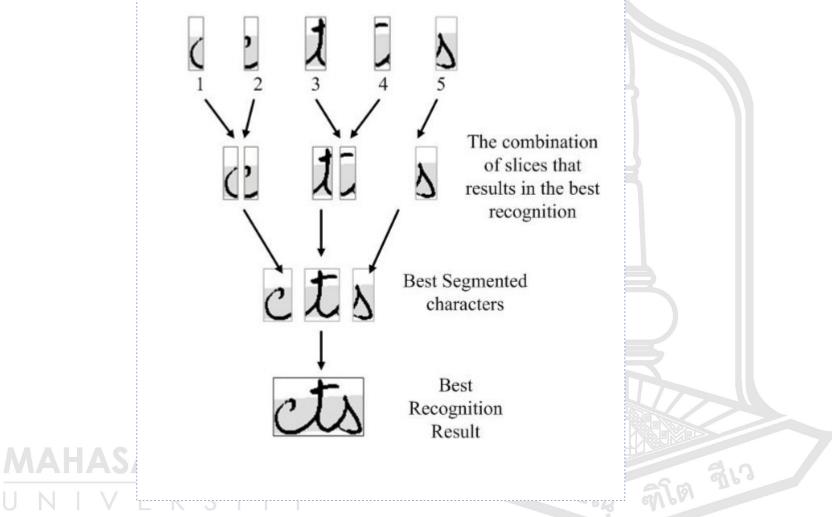
On-line Handwriting Recognition using Support Vector Machines and Hidden Markov Models Approaches

On-line Handwriting Recognition



On-line Handwriting Recognition using Support Vector Machines and Hidden Markov Models Approaches

On-line Handwriting Recognition



On-line Handwriting Recognition using Support Vector Machines and Hidden Markov Models Approaches

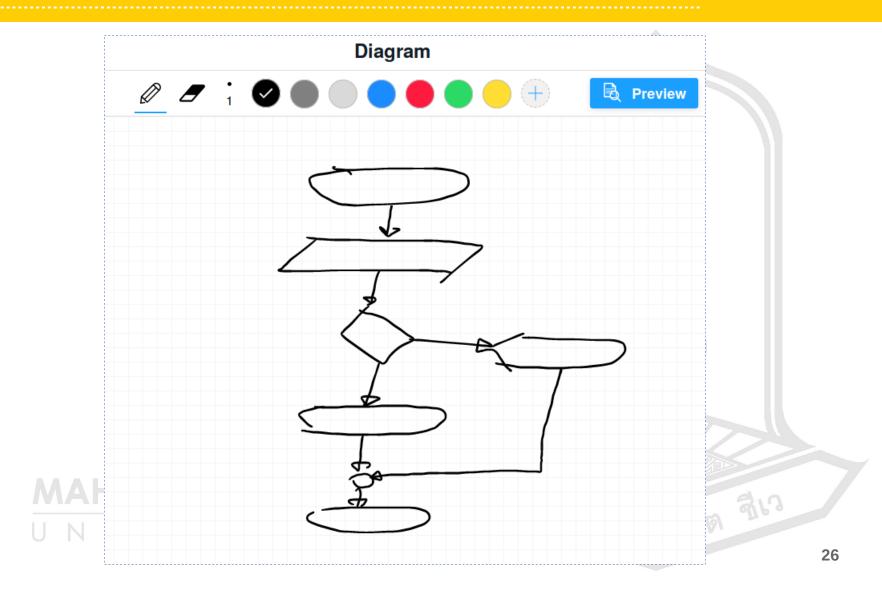
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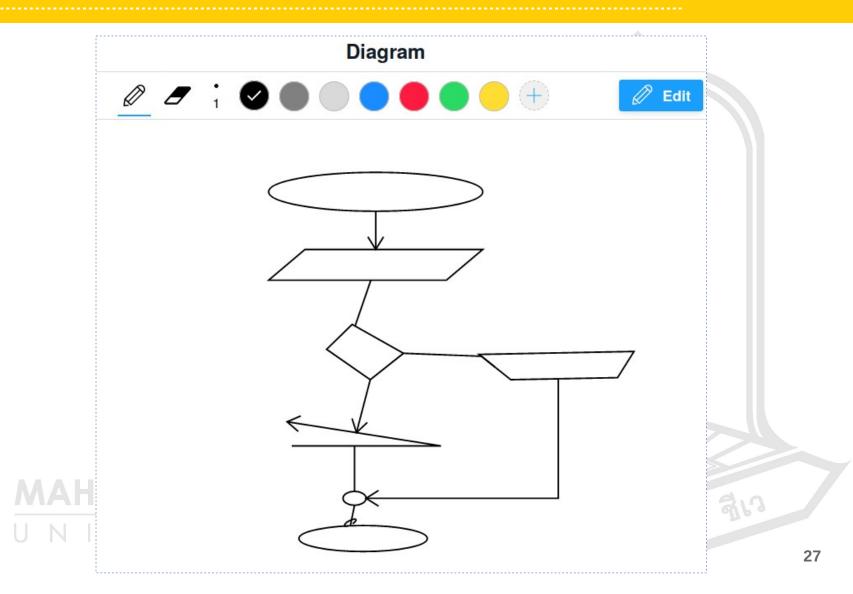
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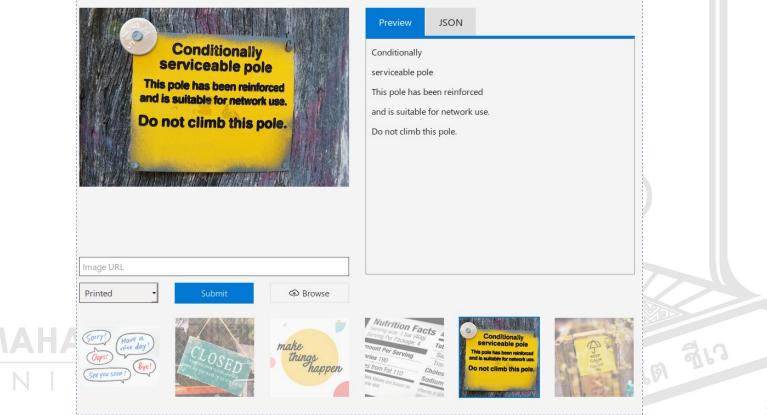


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Demo

https://azure.microsoft.com/en-us/servic es/cognitive-services/computer-vision/



- Image Recognition is a term for computer technologies that can recognize certain people, animals, objects or other targeted subjects through the use of algorithms and machine learning concepts.
- The term "image recognition" is connected to "computer vision," which is an overarching label for the process of training computers to "see" like humans, and "image processing," which is a catch-all term for computers doing

intensive work on image data.

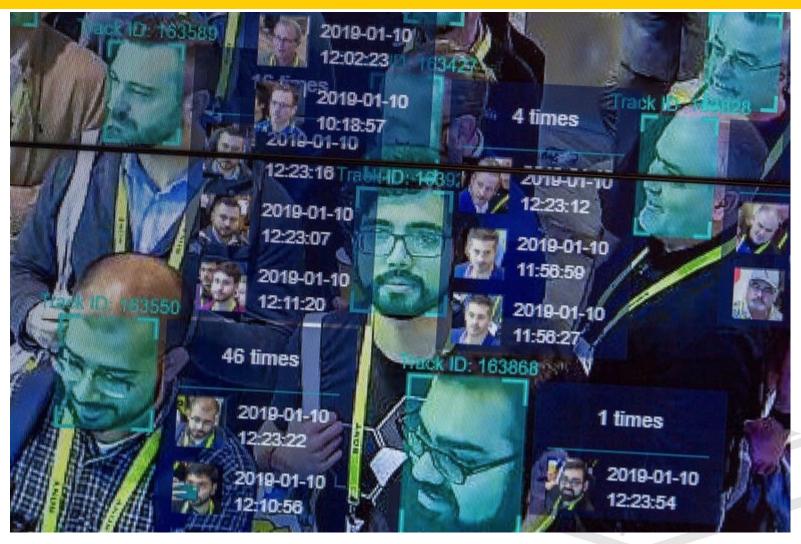
Definition from technopedia.com



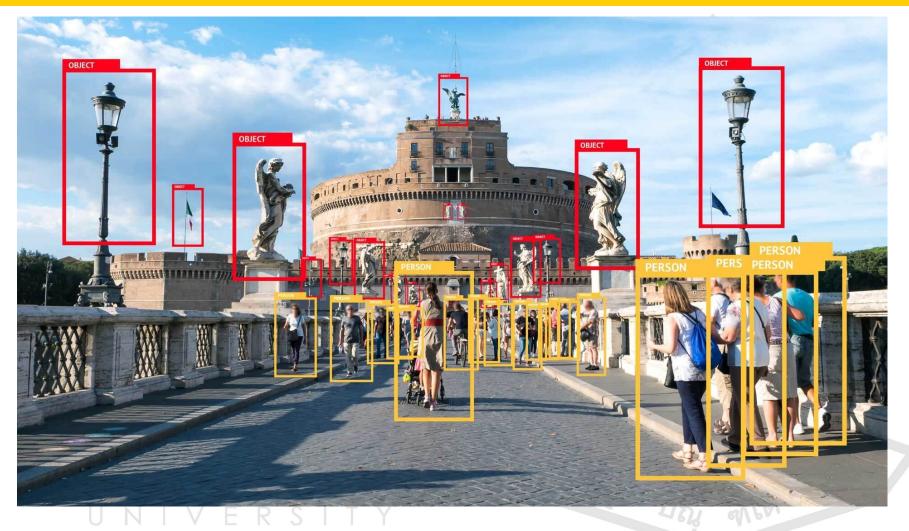
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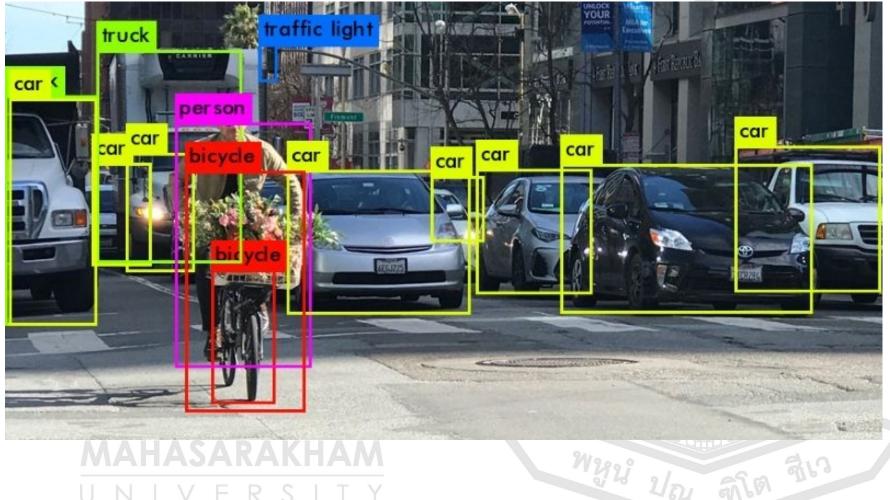
https://thenextweb.com/contributors/2018/10/29/heres-how-face-recognition-tech-can-be-gdpr-compliant/



https://slate.com/technology/2019/01/10-year-challenge-facebook-facial-recognition.html



https://martechtoday.com/how-visual-recognition-is-set-to-change-advertising-223719



33 https://azati.ai/image-detection-recognition-and-classification-with-machine-learning/

Image Segmentation



https://www.vox.com/future-perfect/2019/4/19/18412674/ai-bias-facial-recognition-black-gay-transgender

34

Image Segmentation

Semantic
SegmentationClassification
+ LocalizationImage: Construction of the segmentationImage: ConstructionImage: Construction of the segmentationImage: Construction

GRASS, CAT, TREE, SKY

No objects, just pixels



CAT

Object Detection

DOG, DOG, CAT

Instance Segmentation



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Multiple Object

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https://towardsdatascience.com/mask-r-cnn-for-ship-detection-segmentation-a1108b5a083

Ship Detection & Segmentation



https://towardsdatascience.com/mask-r-cnn-for-ship-detection-segmentation-a1108b5a083

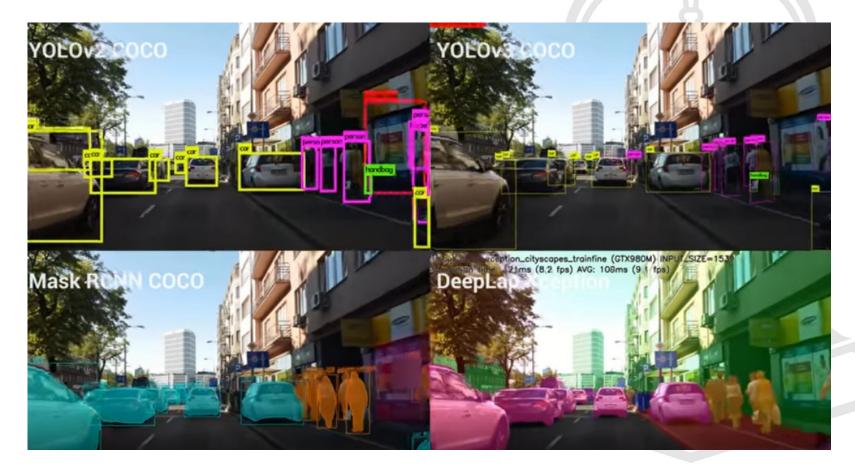
Ship Detection & Segmentation



https://towardsdatascience.com/mask-r-cnn-for-ship-detection-segmentation-a1108b5a083

Image Detection & Segmentation

https://www.youtube.com/watch?v=s8Ui_kV9dhw



Auto-Tagging

https://imagga.com/auto-tagging-demo

Auto-Tagging demo

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Note: By uploading files here you agree to have them temporarily stored in our training dataset for the sole purpose of improving Imagga's technology.



Image URL

| Generated tag | English 🗸 |
|---------------|----------------------|
| Concepts | |
| dragonfly | 100.00% |
| Insect | 100.00% |
| arthropod | <mark>8</mark> 6.79% |
| bug | 59.51% |
| Invertebrate | 46.73% |
| ladybug | 43.19% |
| fly | 41.03% |
| close | 39.38% |
| garden | 38.57% |
| leaf | 37.35% |

↔ show me more tags

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Select one of the following images to see the results:







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Auto-Tagging

https://imagga.com/auto-tagging-demo

📕 Auto-Tagging demo

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| Generated tag | English | • |
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| Concepts | | |
| sport | | 59.44% |
| beach | | 52.96% |
| skate | | 50.00% |
| sea | | 46.19% |
| ocean | | 44.59% |
| active | | 38.89% |
| sand | | 38.68% |
| Jumping | | 37.75% |
| sky | | 35.89% |
| summer | | 35.41% |

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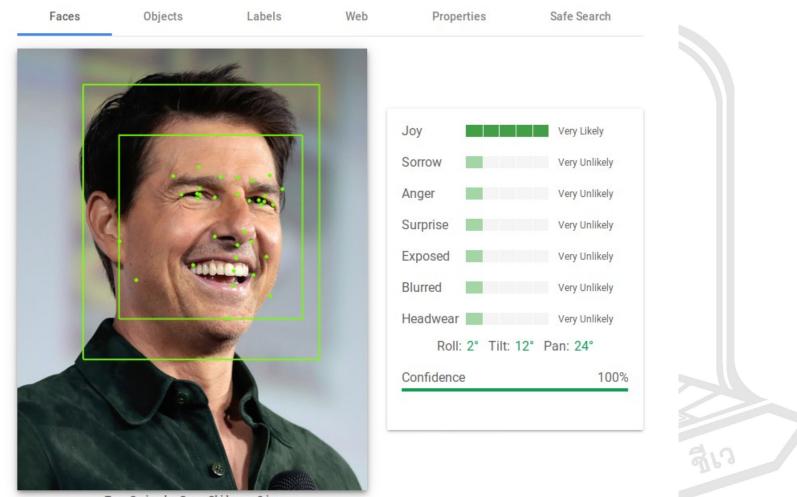
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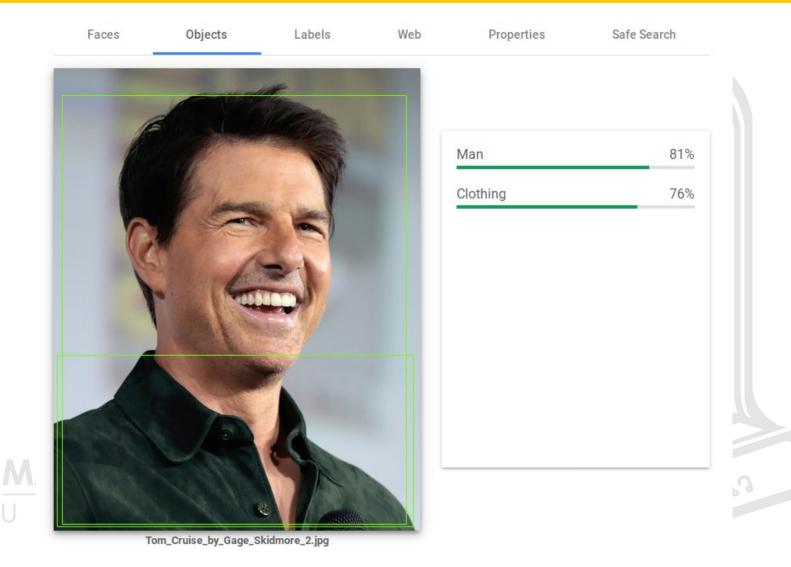
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See Our Full API Documentation



Tom_Cruise_by_Gage_Skidmore_2.jpg

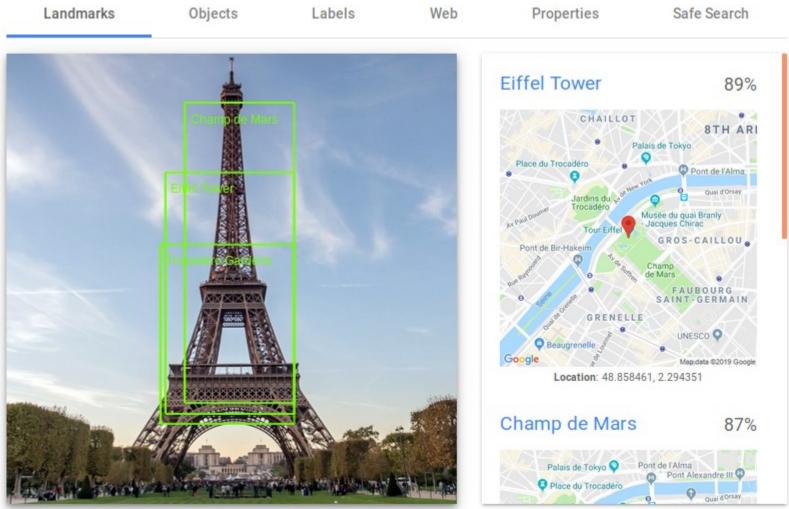


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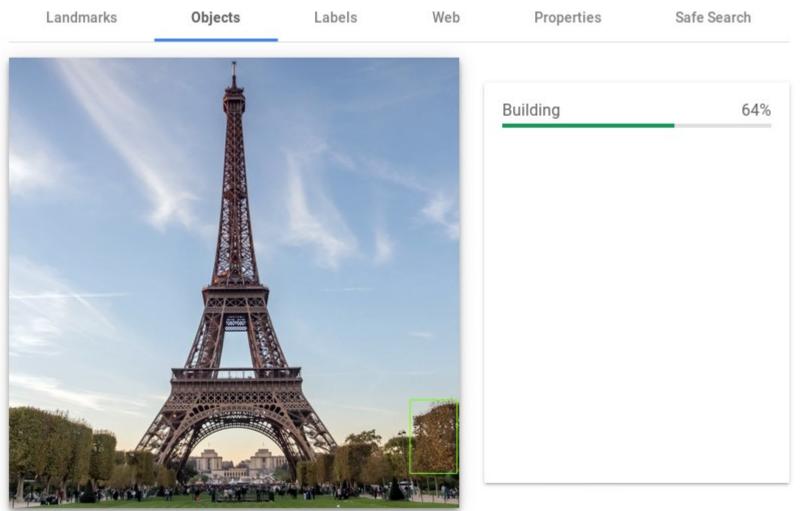
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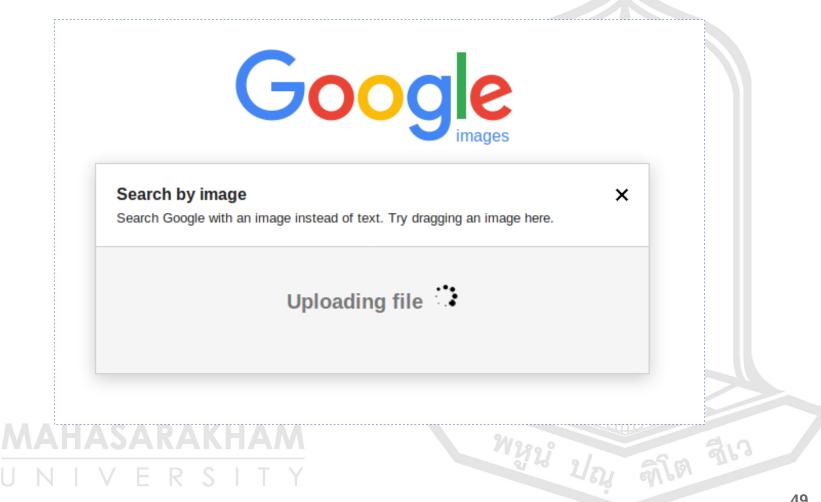
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Google search



Google search

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| student Thomas Cruise Mapother IV that one day in the not too | Height: 1.7 m |
| | Spouse: Katie Holmes (m. 2006–2012), Nicole Kidman (m. 1990–2001), Mimi Rogers (m. 1987–1990) |
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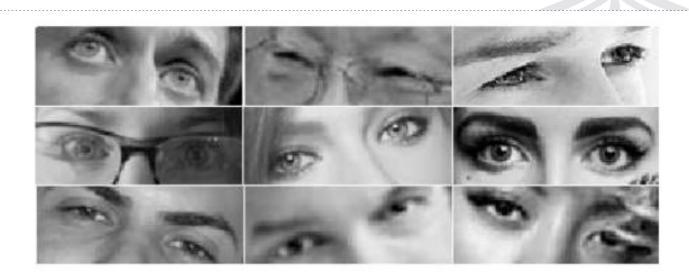


Figure 1: Sample eye-pair regions for training the eye-pair detector.

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In-plane Rotational Alignment of Faces by Eye and Eye-pair Detection

สิโต สีเว



(a)

(b)

Figure 2: Sample eye (a) and non-eye (b) regions cropped from eye-pair image patches. Note that the non-eye regions may still contain eyes, but they are not very precisely located in the center.

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In-plane Rotational Alignment of Faces by Eye and Eye-pair Detection

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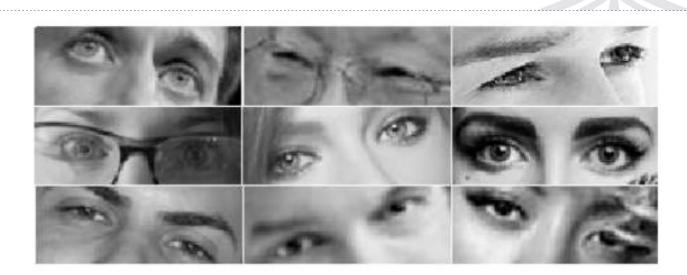


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In-plane Rotational Alignment of Faces by Eye and Eye-pair Detection

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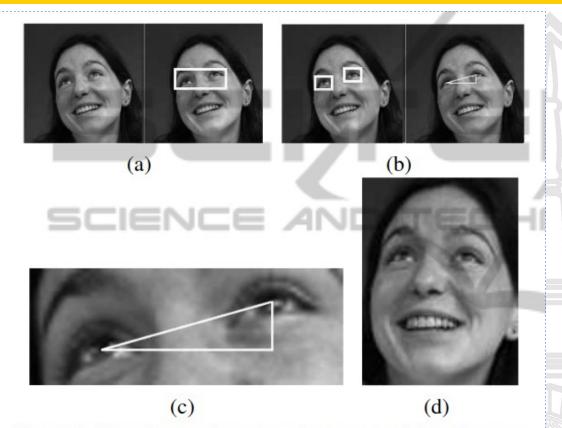
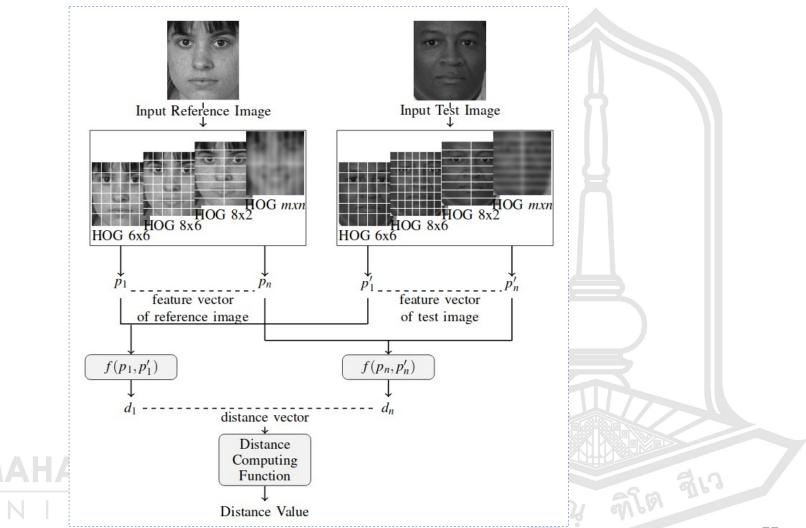


Figure 3: Rotation angle estimation stages: (a) finding eyepair, (b) finding eyes from eye-pair, (c) computing the angle from central coordinates of eyes (17.5° in this example), (d) rotationally aligned face.

In-plane Rotational Alignment of Faces by Eye and Eye-pair Detection

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Robust Face Recognition



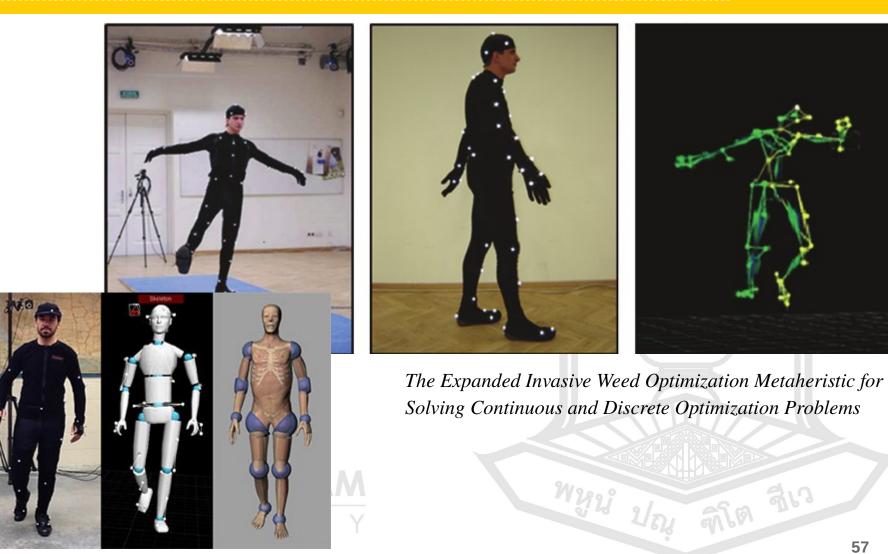
Robust Face Recognition by Computing Distances from Multiple Histograms of Oriented Gradients

Motion capture



https://www.youtube.com/watch?v=kH7msPLVW_k

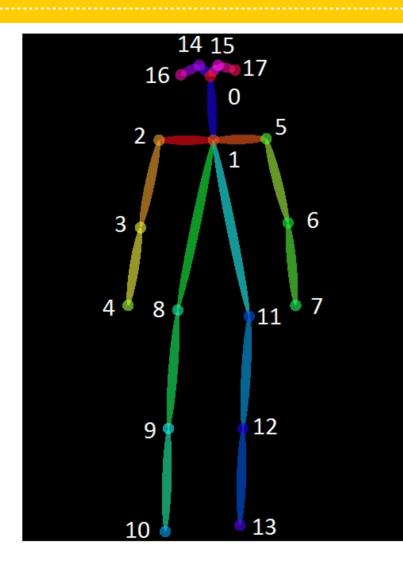
Motion capture



https://neuronmocap.com/content/mocap-101

Pose Estimation

https://www.youtube.com/watch? v=KYNDzlcQMWA





Pose Estimation

https://www.youtube.com/watch? v=pW6nZXeWIGM



Pose Estimation

https://www.youtube.com/watch? v=vTC0QKR_uM0

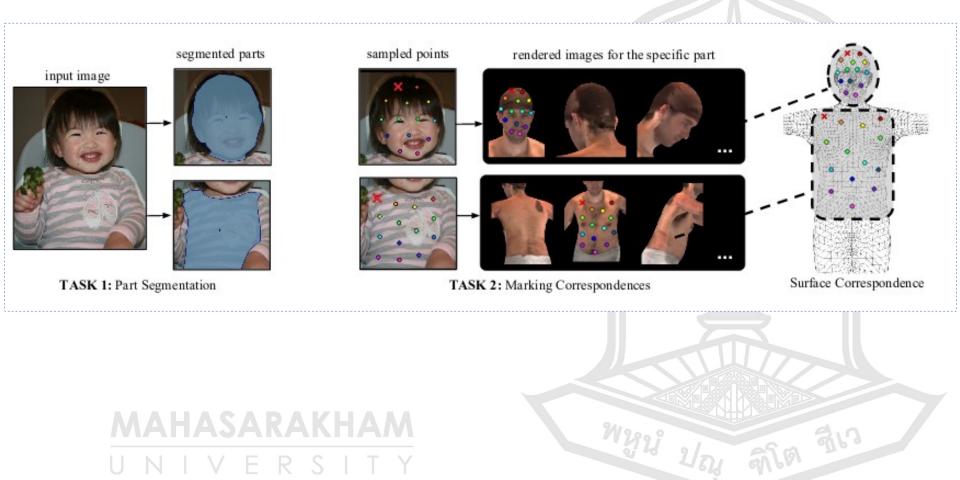


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Dense Human Pose Estimation

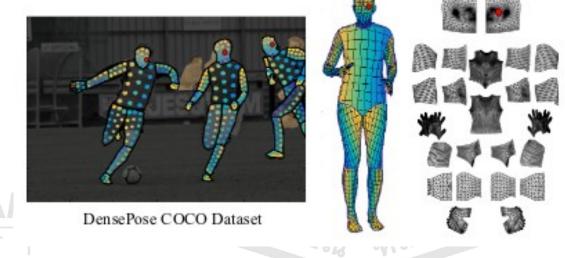


DensePose: Dense Human Pose Estimation in The Wild

Dense Human Pose Estimation



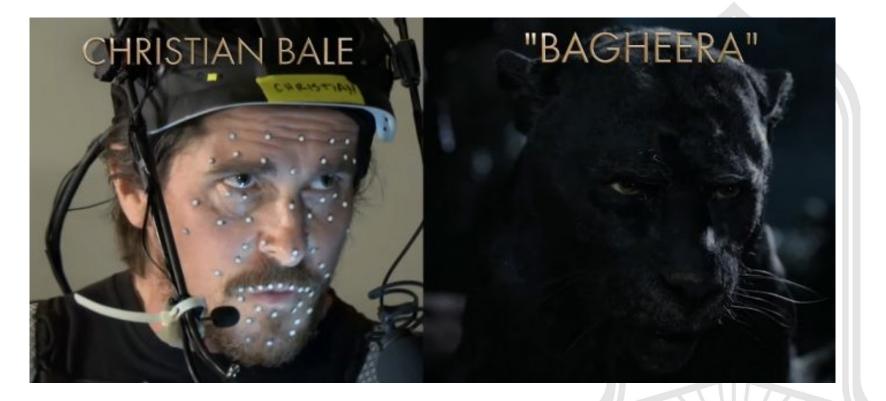
DensePose-RCNN Results





DensePose: Dense Human Pose Estimation in The Wild

Motion capture



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https://www.slashfilm.com/the-morning-watch-the-motion-capture-of-mowgli-whydisney-killed-roger-rabbit-2-more/

Motion capture



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https://srushtivfx.com/how-digital-characters-replicate-human-action-andemotions-motion-capture/

Face Segmentation



Deep face segmentation in extremely hard conditions

Deep Fake

https://www.youtube.com/watch? v=knRGxj37AjM



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Deep Fake



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https://medium.com/datadriveninvestor/facts-in-a-world-of-artificial-intelligencedeepfakes-c073f8791cb6

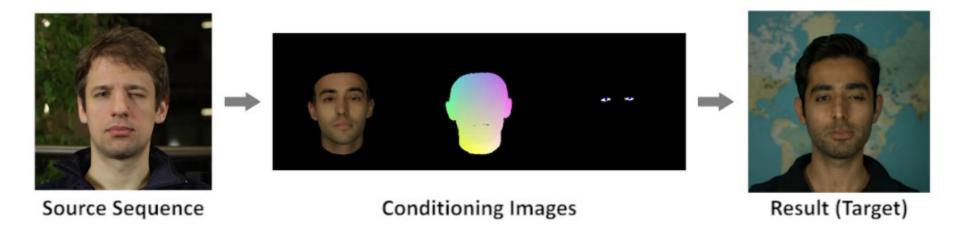


https://www.youtube.com/watch? time_continue=79&v=qc5P2bvfl4

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Results

Full Head Reenactment





Remove Background using Photoshop



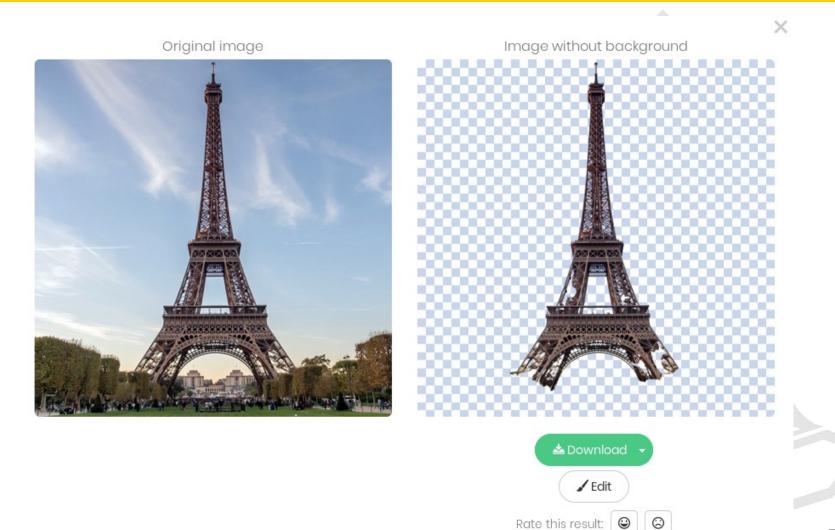
https://www.wikihow.com/Remove-Background-With-Photoshop-Elements

Remove Background using AI



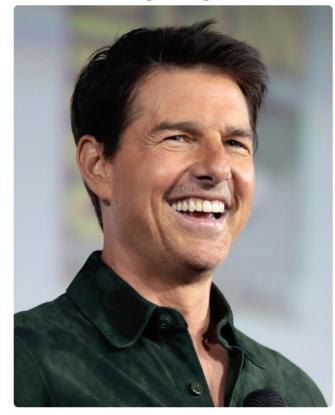
https://www.remove.bg/

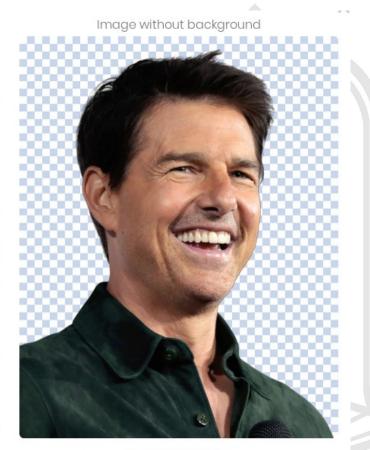
Remove Background using AI



Remove Background using AI

Original image







Remove Background using AI

Original image



Image without background





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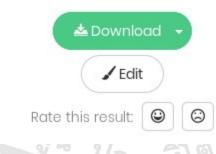
Remove Background using AI

Original image



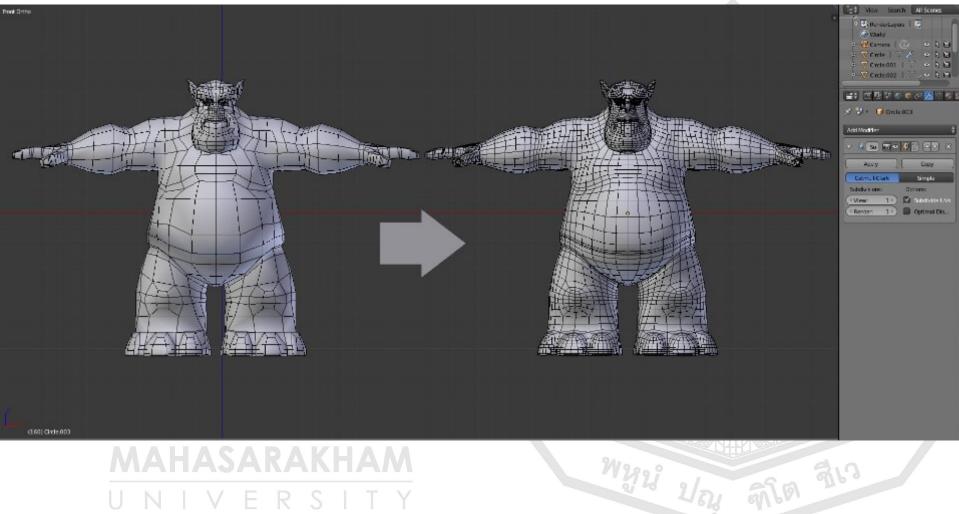
Image without background





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3D Model



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https://www.sculpteo.com/en/glossary/3d-modeling-software-definition/

Estimate a detailed body from a single photo

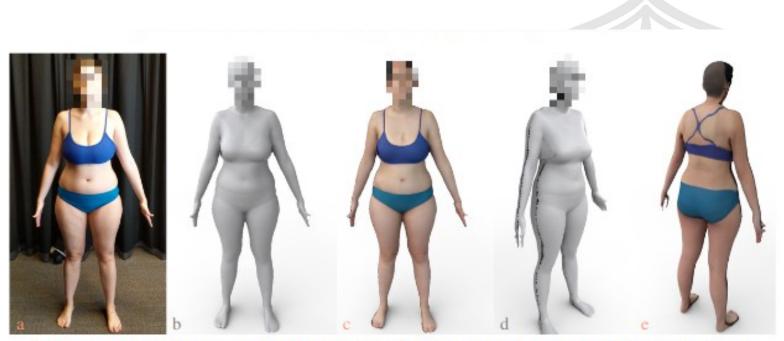


Figure 1: FAX converts a single RGB image (a) into a scan (b, d) with albedo texture (c, e)

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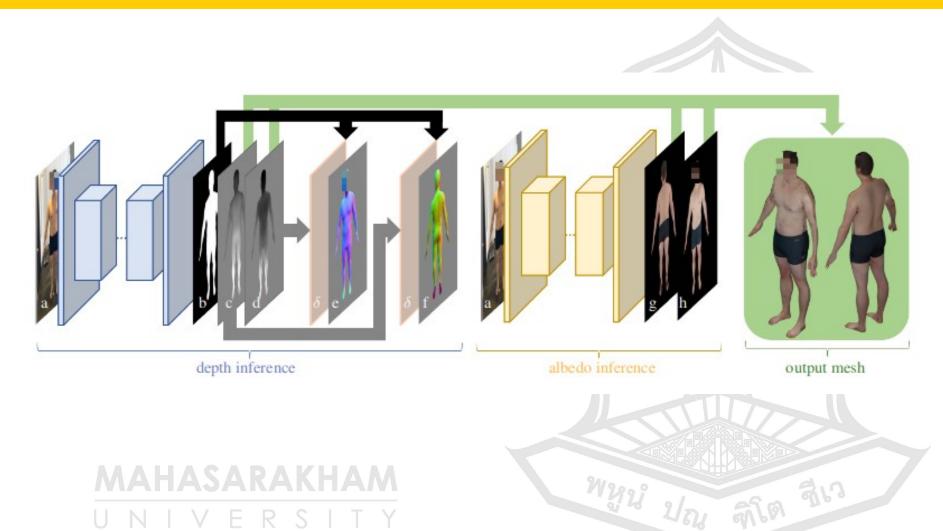
FACSIMILE: Fast and Accurate Scans From an Image in Less Than a Second

Estimate a detailed body from a single photo

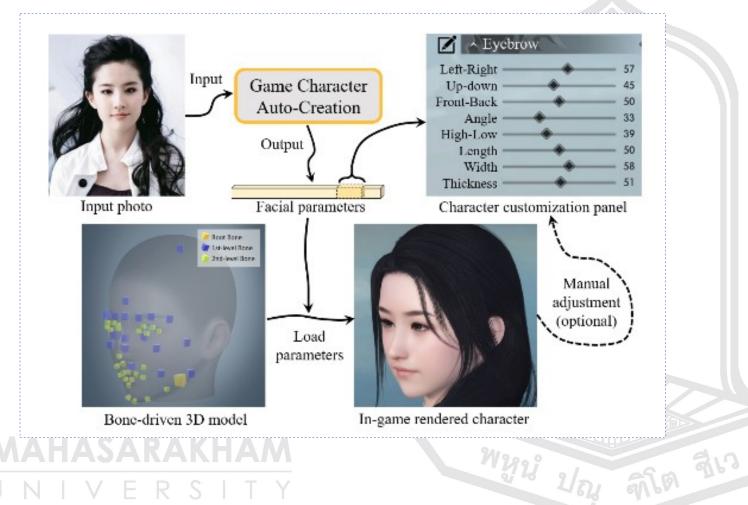


FACSIMILE: Fast and Accurate Scans From an Image in Less Than a Second

Estimate a detailed body from a single photo



FACSIMILE: Fast and Accurate Scans From an Image in Less Than a Second



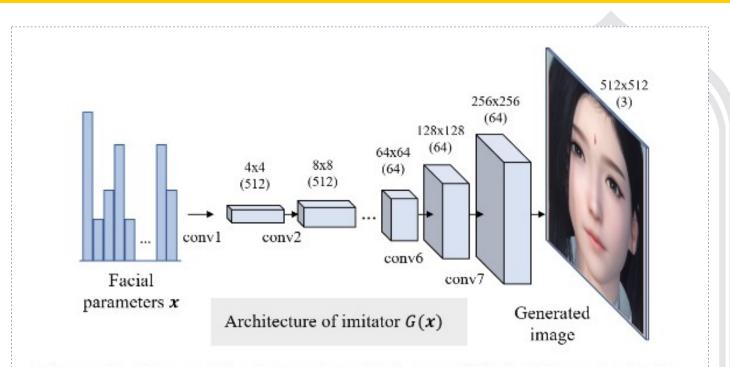


Figure 3. The architecture of our imitator G(x). We train the imitator to learn a mapping from the input facial customization parameters x to the rendered facial image \hat{y} produced by the game engine.



Input photo

Aligned input

Generated character

Generated in-game character (front-view)

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Generated in-game character (side-view)

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Generative Adversarial Networks: GANs



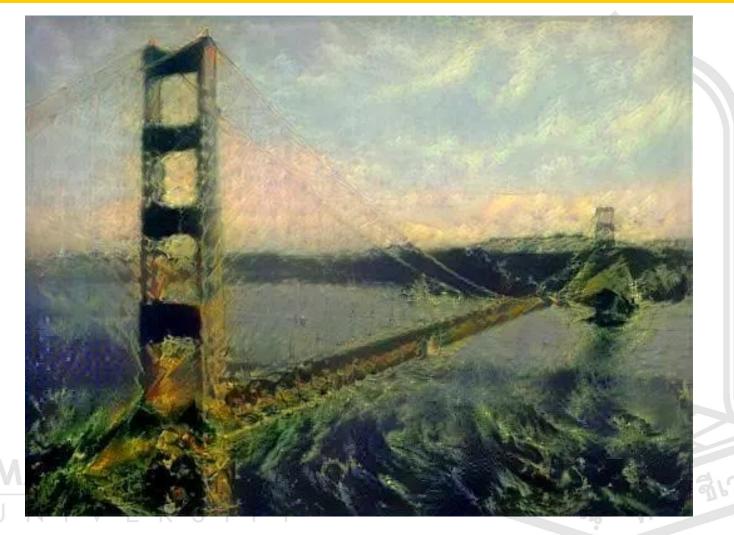
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https://softologyblog.wordpress.com/2019/03/31/style-transfer-gans-generative-adversarial-networks/

Style Transfer

https://markojerkic.com/style-transferkeras/

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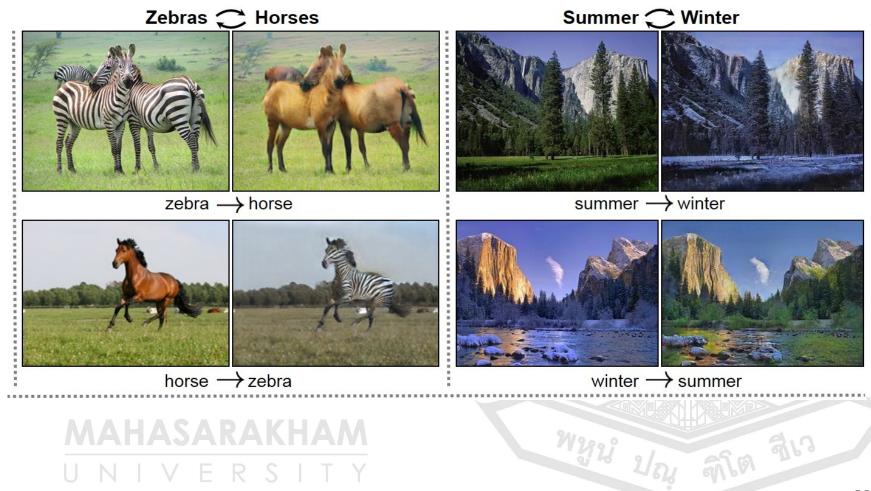


https://markojerkic.com/style-transfer-keras/

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https://markojerkic.com/style-transfer-keras/

Image-to-Image Translation



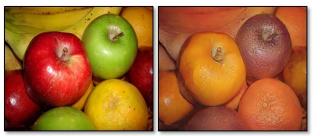
https://github.com/junyanz/CycleGAN

orange \rightarrow apple











apple \rightarrow orange



Input





Output

Input



Input

 $zebra \rightarrow horse$

horse \rightarrow zebra

Output



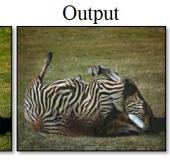


Image-to-Image Translation



https://github.com/junyanz/CycleGAN