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The Art in the Algorithm

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Document Markings

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DM22-0748

Evaluating the Dataset

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Celeb-DF v2

Images sourced from: https://www.cs.albany.edu/~lsw/celeb-deepfakeforensics.html

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Celeb-DF v2

- 590 videos of 59 celebrities collected from YouTube
- 5639 DeepFakes generated
- Gender
  - 56.8% Male
  - 43.2% Female
- Ethnicity
  - 88.1% Caucasian
  - 5.1%Asian
  - 6.8% Black & Brown
- Age Distribution:
  - 65.6% 40 and older
  - 34.4% under 40

Images sourced from: https://www.cs.albany.edu/~lsw/celeb-deepfakeforensics.html

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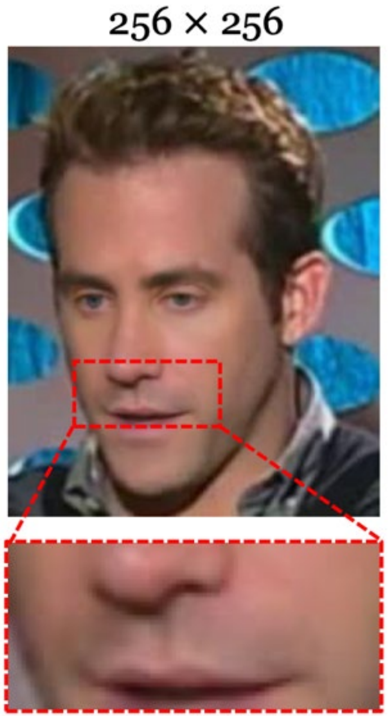
Celeb-DF v2



- Recognized the need for higher quality source material
- Used custom algorithm
- Encoding 256 bit
- Decoding 256 bit
- Color correction applied at training
- Kalman smoothing algorithm to reduce temporal flicker
- Facial landmark masking
- Smoothness mask to blend overlay

Images sourced from: https://www.cs.albany.edu/~lsw/celeb-deepfakeforensics.html

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Celeb-DF v2 – Compression

Video ID	Codec Wrapper	General Format_Profile	General CodecID/String	General FileSize/String	General Duration/String	General OverallBitRate_Mode/String	General OverallBitRate/String	General Encoded_Application/String	Video 0 FrameRate/String	Video 0 ColorSpace	Video 0 ChromaSubsampling/String	Video 0 BitDepth/String	Video 0 ScanType/String	Video 0 Compression_Mode/String	Video 0 Bits-(Pixel*Frame)	Video 0 StreamSize/String	Video 0 Encoded_Library/String
id0_id16_0000.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.10 MiB	15 s 634 ms	Variable	1 127 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.08	2.10 MiB (100%)	Lavc58.6.103
id0_id16_0001.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	1.47 MiB	10 s 100 ms	Variable	1 219 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.086	1.47 MiB (100%)	Lavc58.6.103
id0_id16_0002.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	1.51 MiB	11 s 667 ms	Variable	1 089 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.077	1.51 MiB (100%)	Lavc58.6.103
id0_id16_0003.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.05 MiB	17 s 634 ms	Variable	975 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.069	2.05 MiB (100%)	Lavc58.6.103
id0_id16_0004.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.13 MiB	10 s 867 ms	Variable	1 643 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.116	2.13 MiB (100%)	Lavc58.6.103
id0_id16_0005.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.02 MiB	15 s 300 ms	Variable	1 106 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.078	2.01 MiB (100%)	Lavc58.6.103
id0_id16_0006.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	3.35 MiB	17 s 800 ms	Variable	1 580 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.111	3.35 MiB (100%)	Lavc58.6.103
id0_id16_0007.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.02 MiB	15 s 967 ms	Variable	1 063 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.075	2.02 MiB (100%)	Lavc58.6.103
id0_id16_0008.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	4.08 MiB	15 s 467 ms	Variable	2 211 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.156	4.07 MiB (100%)	Lavc58.6.103
id0_id16_0009.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.34 MiB	17 s 334 ms	Variable	1 135 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.08	2.34 MiB (100%)	Lavc58.6.103
id0_id17_0000.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.10 MiB	15 s 634 ms	Variable	1 126 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.079	2.10 MiB (100%)	Lavc58.6.103
id0_id17_0001.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	1.47 MiB	10 s 100 ms	Variable	1 221 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.086	1.47 MiB (100%)	Lavc58.6.103
id0_id17_0002.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	1.52 MiB	11 s 667 ms	Variable	1 090 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.077	1.51 MiB (100%)	Lavc58.6.103
id0_id17_0003.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.04 MiB	17 s 634 ms	Variable	970 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.068	2.04 MiB (100%)	Lavc58.6.103
id0_id17_0005.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.03 MiB	15 s 300 ms	Variable	1 113 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.078	2.03 MiB (100%)	Lavc58.6.103
id0_id17_0006.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	3.35 MiB	17 s 800 ms	Variable	1 578 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.111	3.35 MiB (100%)	Lavc58.6.103
id0_id17_0007.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.02 MiB	15 s 967 ms	Variable	1 061 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.075	2.02 MiB (100%)	Lavc58.6.103
id0_id17_0009.mp4	MPEG-4	Base Media	isom (isom/iso2/mp41)	2.35 MiB	17 s 334 ms	Variable	1 136 kb/s	Lavf58.3.100	30.000 FPS	YUV	4:02:00 AM	8 bits	Progressive	Lossy	0.08	2.34 MiB (100%)	Lavc58.6.103
id0_id1_0000.mp4																	
id0_id1_0001.mp4																	
id0_id1_0002.mp4																	
id0_id1_0003.mp4																	
id0_id1_0005.mp4																	
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General Duration/String	General OverallBitRate_Mode/String	General OverallBitRate/String	General Encoded_Application/String	Video 0 FrameRate/String
15 s 634 ms	Variable	1 127 kb/s	Lavf58.3.100	30.000 FPS
10 s 100 ms	Variable	1 219 kb/s	Lavf58.3.100	30.000 FPS
11 s 667 ms	Variable	1 089 kb/s	Lavf58.3.100	30.000 FPS
17 s 634 ms	Variable	975 kb/s	Lavf58.3.100	30.000 FPS
10 s 867 ms	Variable	1 643 kb/s	Lavf58.3.100	30.000 FPS
15 s 300 ms	Variable	1 106 kb/s	Lavf58.3.100	30.000 FPS
17 s 800 ms	Variable	1 580 kb/s	Lavf58.3.100	30.000 FPS
15 s 967 ms	Variable	1 063 kb/s	Lavf58.3.100	30.000 FPS
15 s 467 ms	Variable	2 211 kb/s	Lavf58.3.100	30.000 FPS
17 s 334 ms	Variable	1 135 kb/s	Lavf58.3.100	30.000 FPS
15 s 634 ms	Variable	1 126 kb/s	Lavf58.3.100	30.000 FPS
10 s 100 ms	Variable	1 221 kb/s	Lavf58.3.100	30.000 FPS
11 s 667 ms	Variable	1 090 kb/s	Lavf58.3.100	30.000 FPS
17 s 634 ms	Variable	970 kb/s	Lavf58.3.100	30.000 FPS
15 s 300 ms	Variable	1 113 kb/s	Lavf58.3.100	30.000 FPS
17 s 800 ms	Variable	1 578 kb/s	Lavf58.3.100	30.000 FPS
15 s 967 ms	Variable	1 061 kb/s	Lavf58.3.100	30.000 FPS
17 s 334 ms	Variable	1 136 kb/s	Lavf58.3.100	30.000 FPS
15 s 634 ms	Variable	1 127 kb/s	Lavf58.3.100	30.000 FPS

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The Art in the Algorithm

Evaluating the Dataset

Where do you want to go?

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Selecting a target subject

Public figures historically are easier targets.

Conferencing, social media and tube sites can make us all targets.

The more available footage the better

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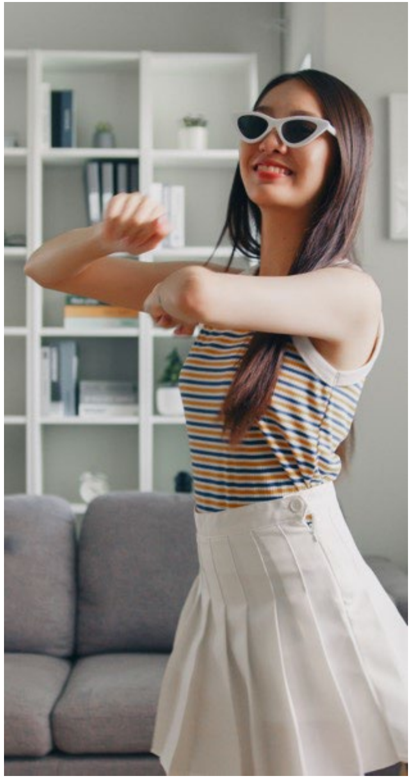
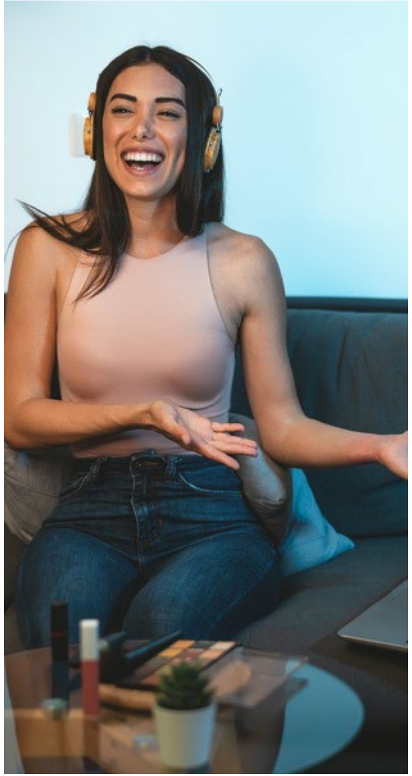
Curating found content





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Evaluating the Dataset

Art is born of observation

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Details Matter

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When Source and destination do not match

Images sourced from Celeb-DF Dataset

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Better body shape but...

Image sourced from Celeb-DF Dataset

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How can we improve a dataset?

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Replicate the target for success

Image sourced from VFXChris Ume YouTube Channel – Deepfake breakdown of Tom Cruise

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Angles and Expressions

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Curating Source Files

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The Art in the Algorithm

How can we improve the dataset?

What would Hollywood do?

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Example 1: The Basics

Original
id41_0009, Natalie Portman

Synthesis
id41_id42_0009, Eva Mendes

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Organizing the Project

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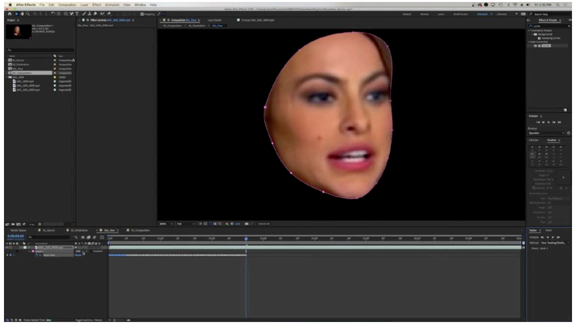
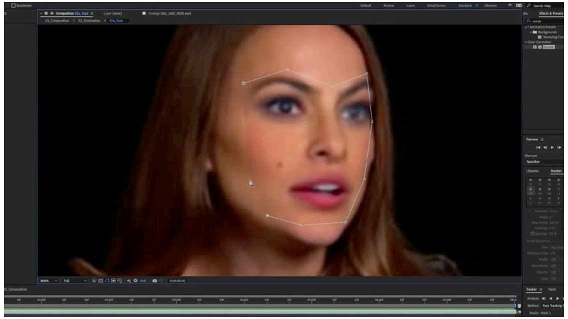
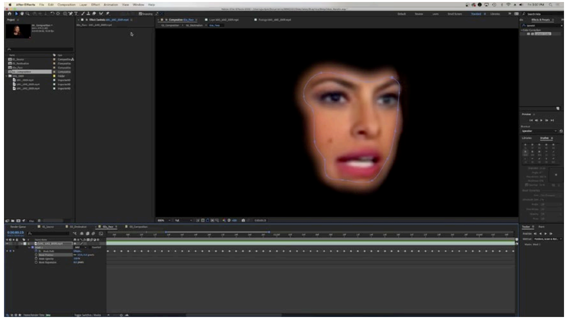
Masking & Feathering



V1: Tracking



V2: Rudimentary Mask



V3: Refining

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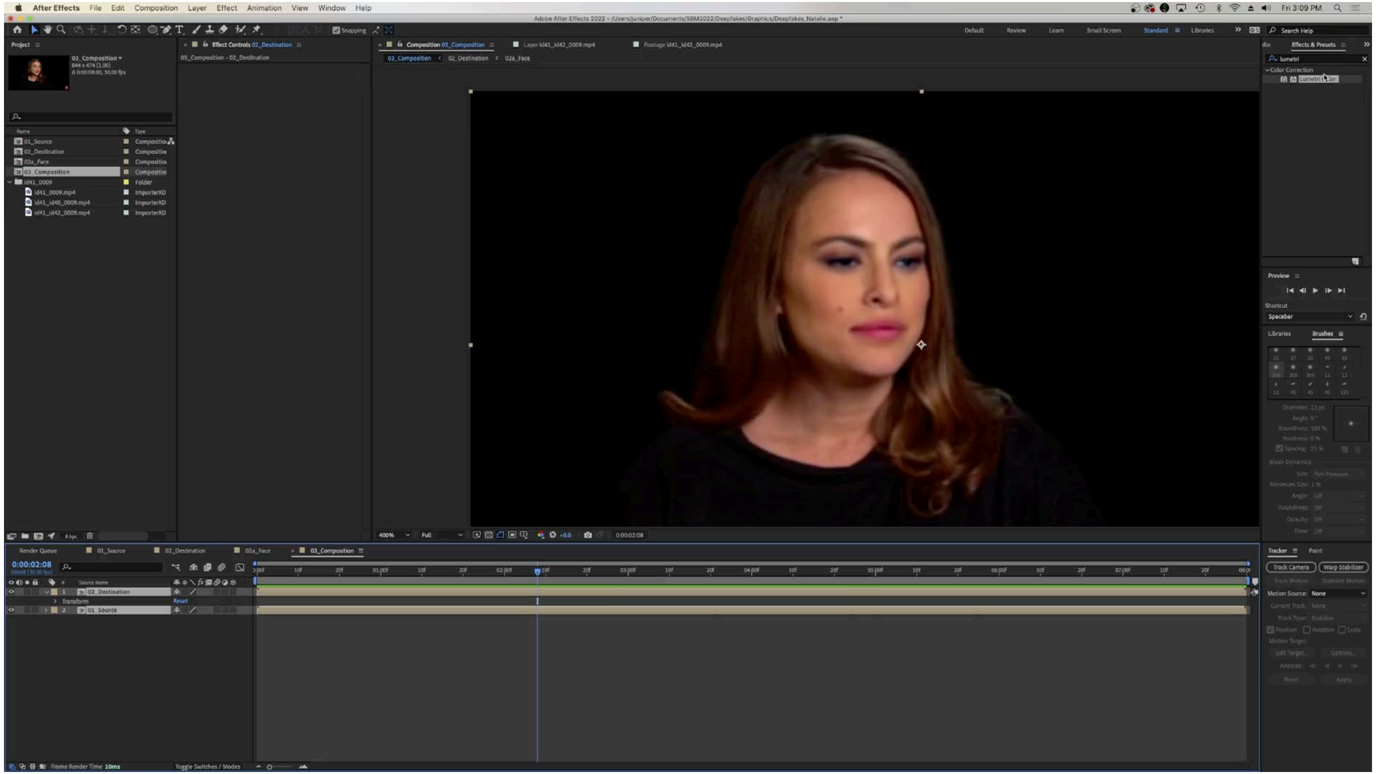
Color Correction



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Results

Synthesis
id41_id42_0009, Eva Mendes

Synthesis (corrected)
id41_id42_0009, Eva Mendes

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Detail Transfer

Original
id28_0002, Jude Law

Synthesis
id28_id22_0002, Mark Wahlberg

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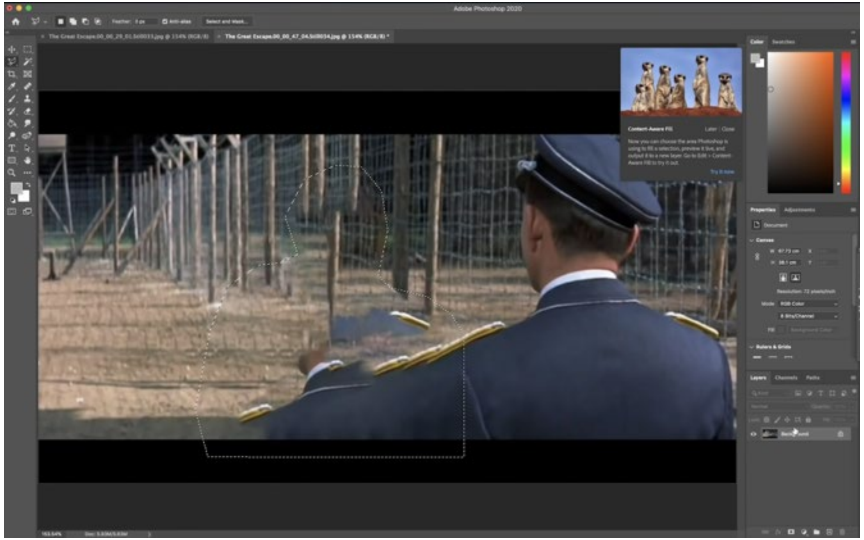
Background Replacement



Photoshop → After Effects Workflow
Content Aware Fill
Clone Stamp Tool

Images sourced from Steve Ramsden (YouTube)

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Example 2: Level Up

Original
id52_0009, Cate Blanchett

Synthesis
id52_id49_0004, Miley Cyrus

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Breaking a Deepfake

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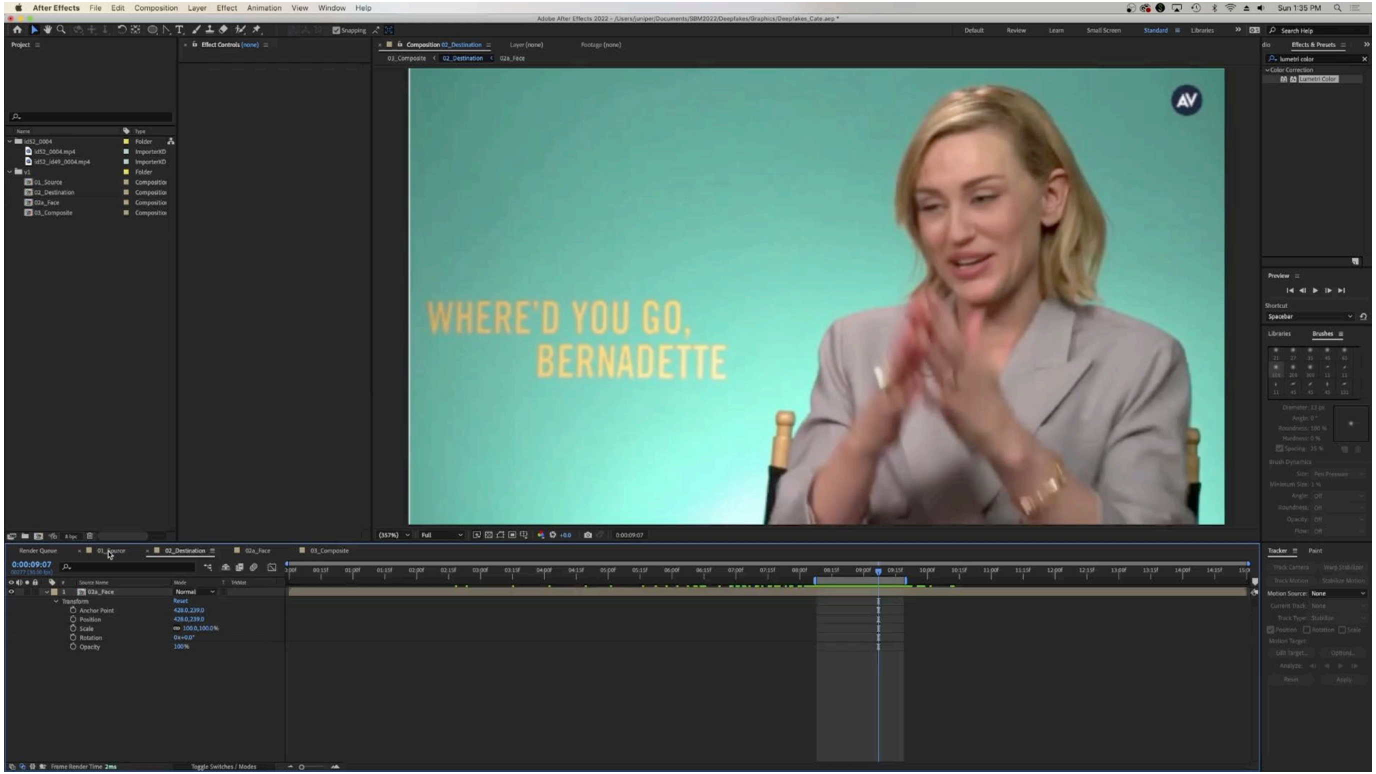
Setup Considerations



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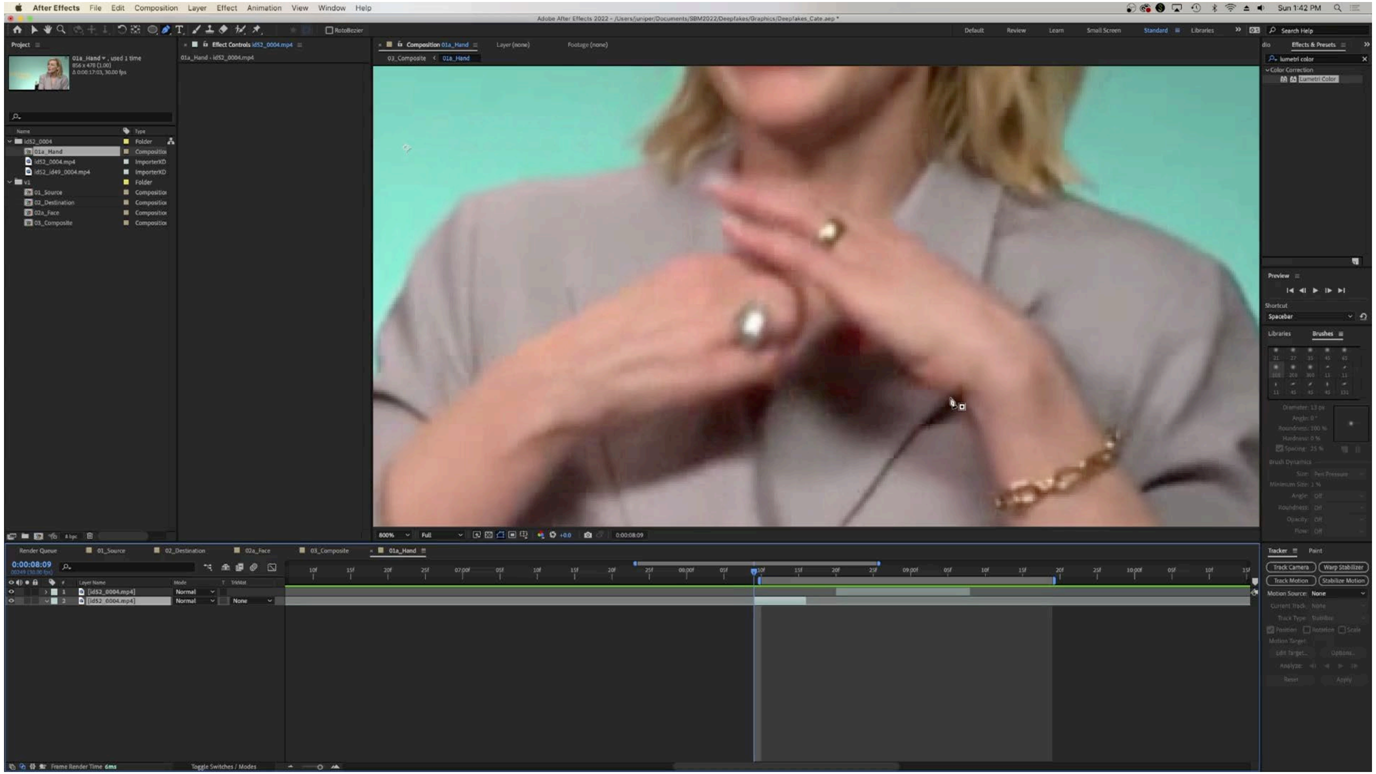
Masking & Feathering



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Color Correction

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Results

Synthesis
id52_id49_0004, Miley Cyrus

Synthesis (corrected)
id52_id49_0004, Miley Cyrus

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Fast-forward the evolution

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What happens when encoder/decoder is increased x4

Image sourced from PAGI Studios YouTube Channel

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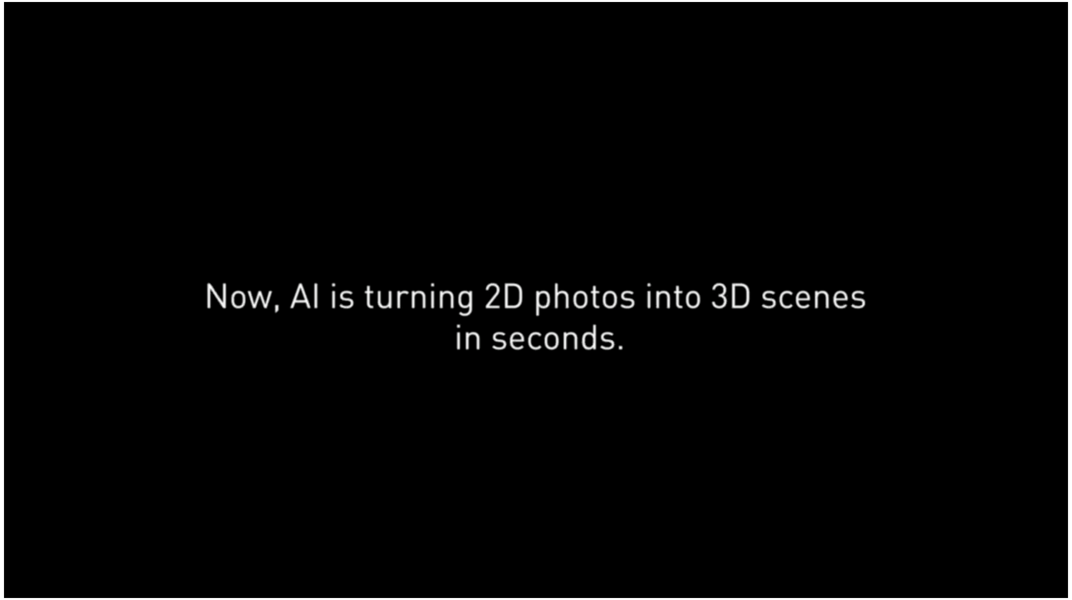
Puppet mastery enhanced with NERF



Video sourced from NVIDIA Developer YouTube

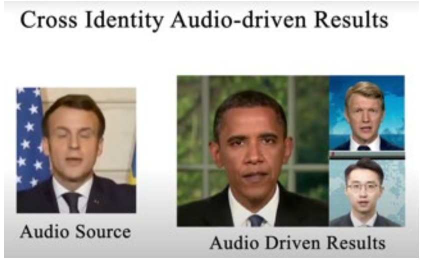


Image sourced from AD-NeRF: Guo Yudong YouTube

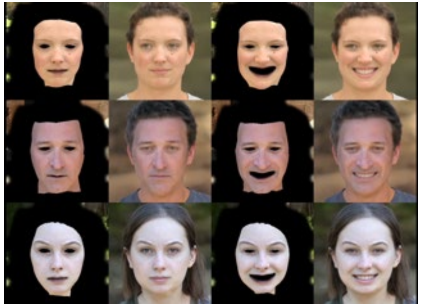


Image sourced from Disney Research YouTube

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What are Metahumans

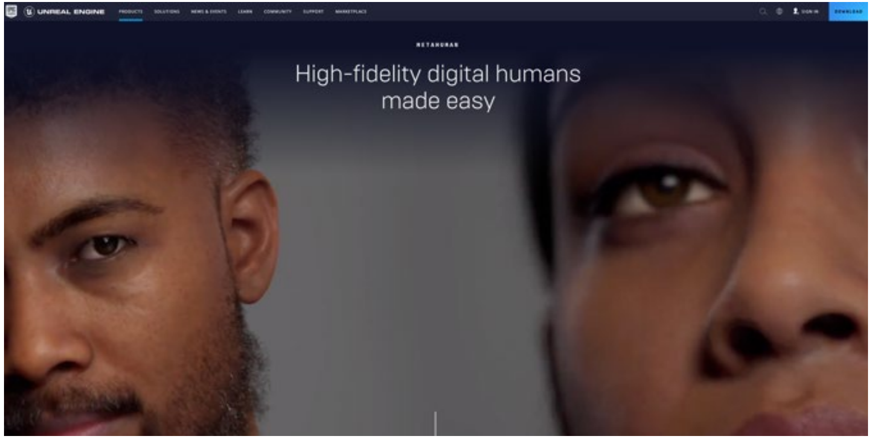

Photo sourced from Unreal

- Data comes from real life scans
- Rigged for animation with live performance capture.
- Tutorials readily available

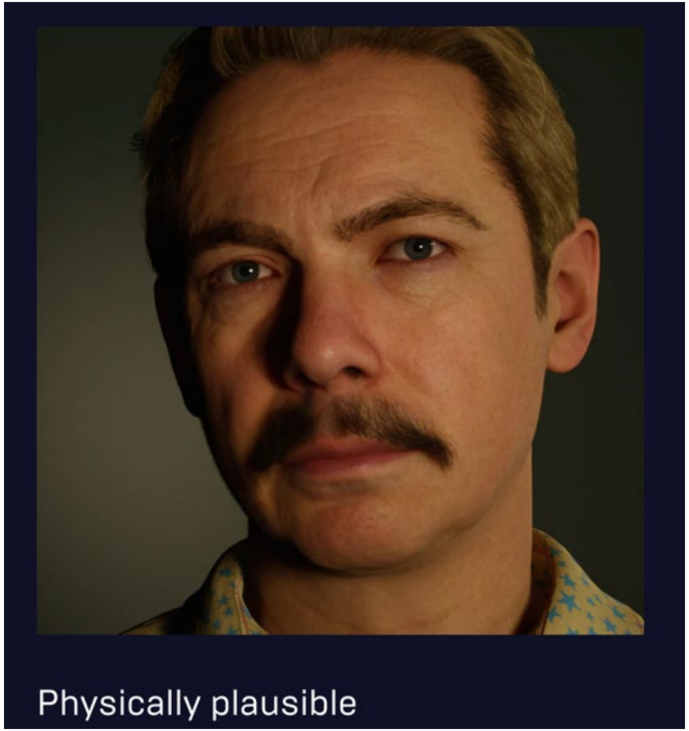

Photo sourced from Unreal

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Mesh to Metahuman

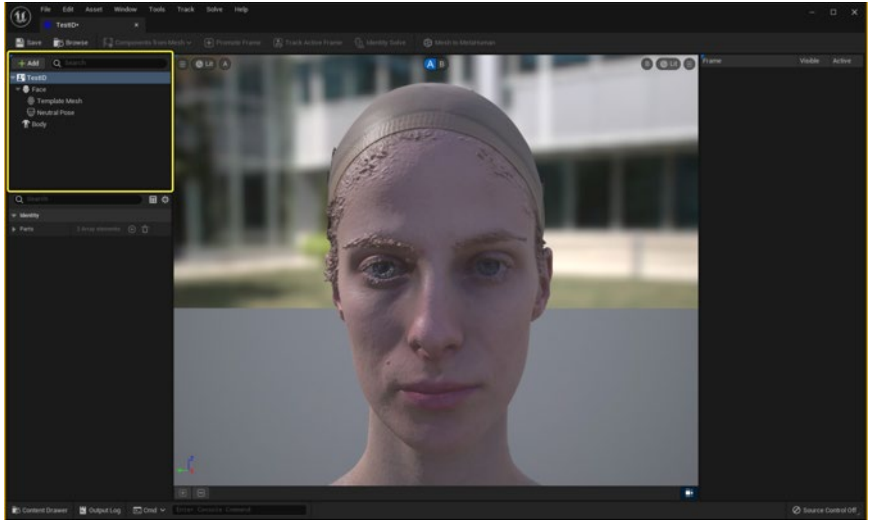

Photo sourced from Unreal

- Photo/Lidar Smartphone App
- 30+ images can create a model
- Neutral Expression
- Mouth Closed
- Even bright lighting
- Model does not have to be water-tight.
- Set Body parameters
- Metahuman Mesh can be created in as little as 10 minutes.

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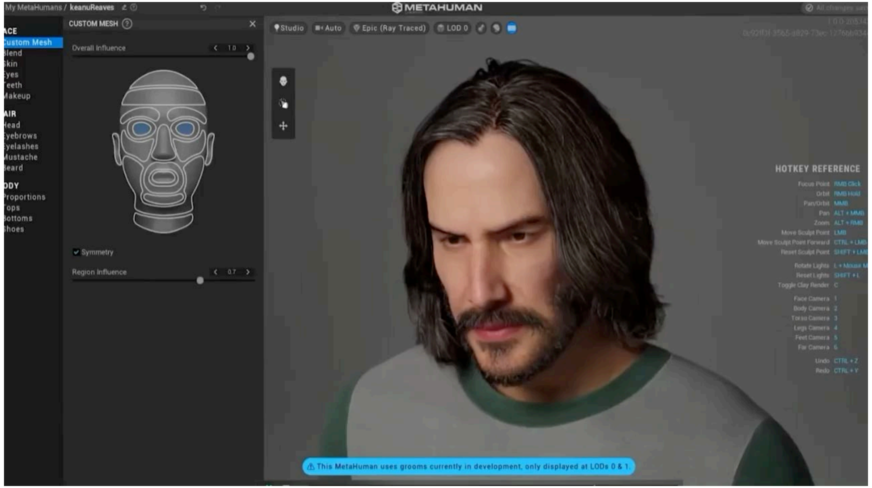
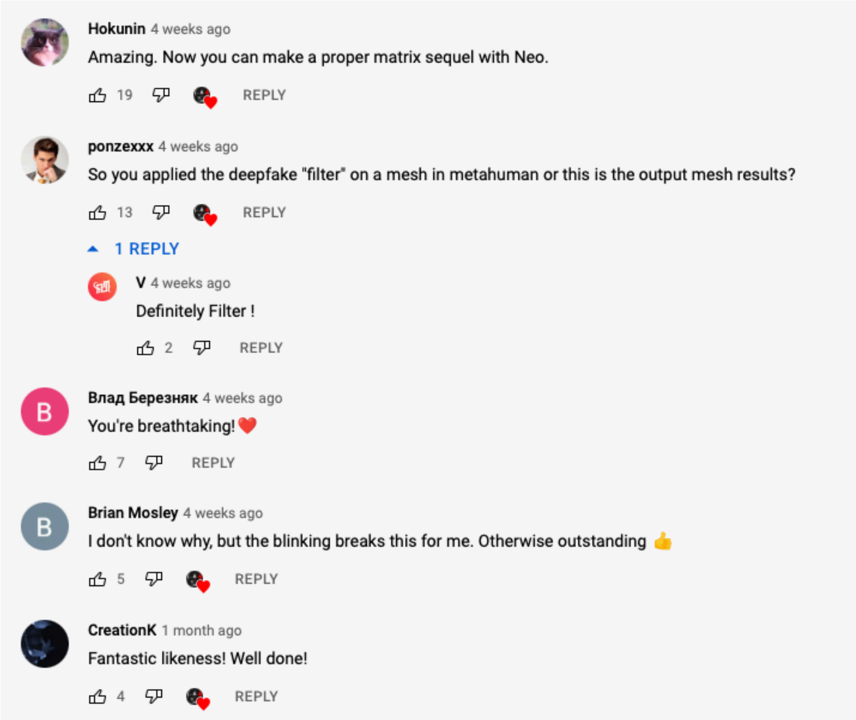
Metahumans Deepfakes

Created by NotFace Studio





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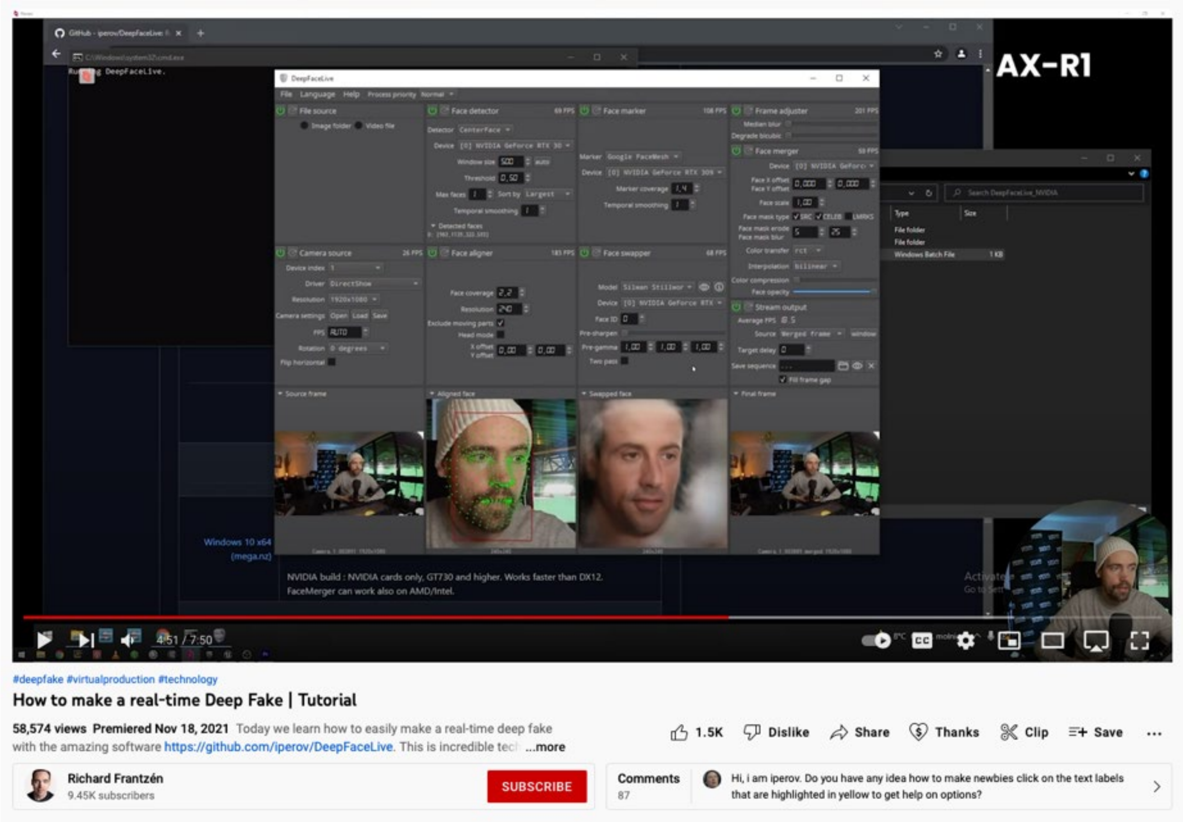
DeepFaceLab Live



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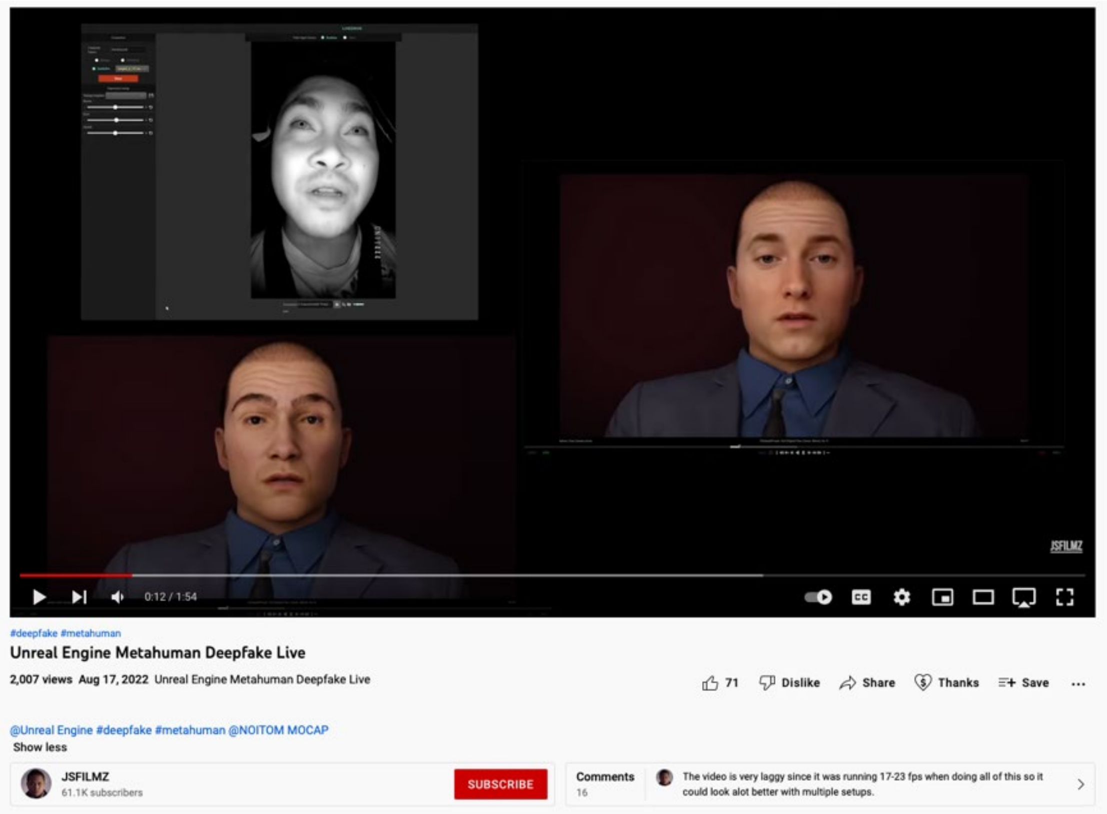
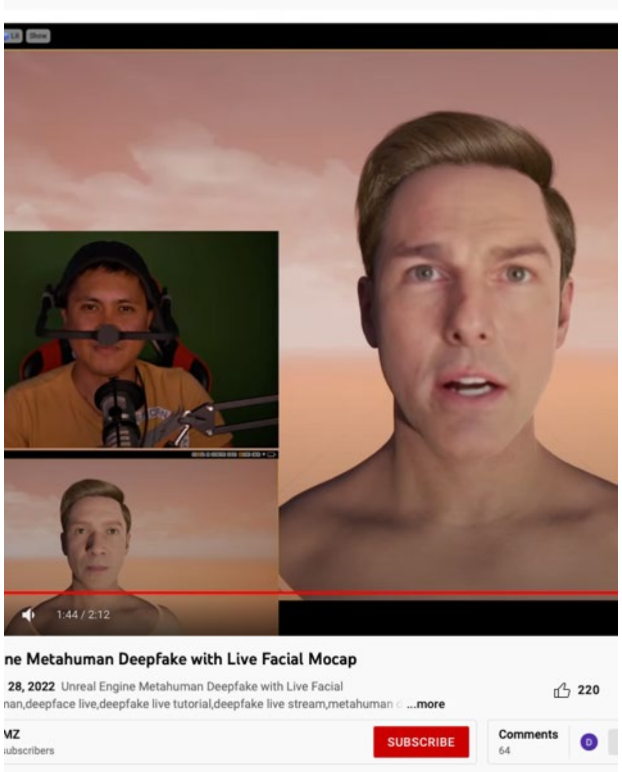
DeepFaceLab Live + Unreal Engine 5





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Live Deepfakes are successful manipulating leaders

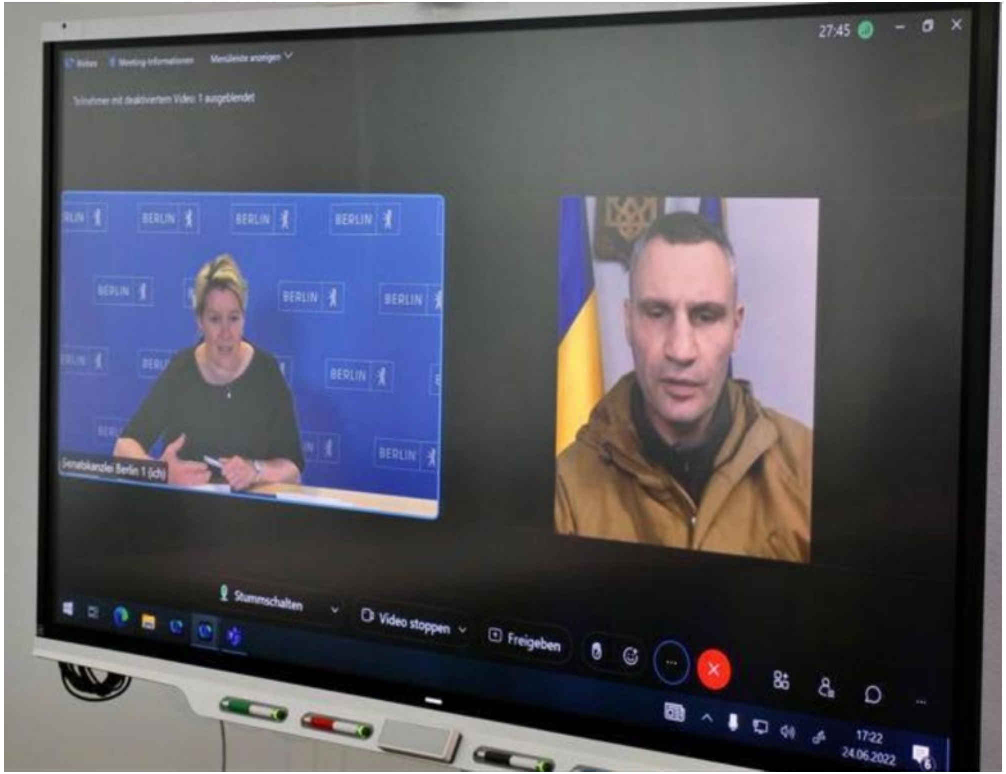

Photo sourced from Senatskanzlei Berlin Twitter feed

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