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Sincerely,  
Diya P. Presswala

# Deep Fake

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## 1. Abstract

- “Deep Fakes” is a popular image synthesis technique based on artificial intelligence. It is like a simulation, which is using computer technology to turn real images and video into fake images and videos that is already quite a new drift.
- Deep learning has been successfully applied to solve various complex problems ranging from big data analytics to computer vision and human-level control.
- It is more powerful than traditional image-to-image translation as it can generate images without given paired training data.

The goal of “Deep Fakes” is to capture common characteristics from a collection of existed images and to figure out a way of enduing other images with those characteristics, e.g. shapes and styles.



- Deepfakes uses deep learning technology to manipulate images and videos of a person that humans cannot differentiate them from the real one.

- In recent years, many studies have been conducted to understand how deep fakes work and many approaches based on deep learning have been introduced to detect deep fakes videos or images.
- In this paper, we conduct a comprehensive review of deepfakes creation and detection technologies using deep learning approaches.
- In addition, we give a thorough analysis of various technologies and their application in deepfakes detection. Deepfakes are generated using adversarial generative networks, where two models of machine learning exist.
- One model trains a dataset then generates deep-fakes, and the other model is to detect Deepfakes.
- Nowadays, deepfake is wreaking havoc on society. Deepfake content is created with the help of artificial intelligence and machine learning to replace one person's likeness with another person in pictures or recorded videos.
- Deepfake uses the latest technology like Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) to construct automated methods for creating fake content that is becoming increasingly difficult to detect with the human eye.
- We present extensive discussions on challenges, research trends and directions related to deepfake technologies. By reviewing the background of deepfakes and state-of-the-art deepfake detection methods, this study provides a comprehensive overview of deepfake techniques

## 2. Introduction

It's called "deepfake" because it combines two words: "deep learning" and "fake". "Deep learning" is a type of computer technology that can learn and understand things in a similar way to how humans do.

It's often used in tasks like recognizing faces or understanding speech. "Fake" means something that's not real or genuine. So, when you put "deep learning" and "fake" together, you get "deepfake".

Deepfake are created by techniques that can superimpose face images of a target person onto a video of a source person to make a video of the target person doing or saying things the source person does. This constitutes a category of deepfakes, namely face swap.



In a broader definition, deepfakes are artificial intelligence-synthesized content that can also fall into two other categories, i.e., lip-sync and puppet master. Lip-sync deepfakes refer to videos that are modified to make the mouth movements consistent with an audio recording. Puppet-master deepfakes include videos of a target person (puppet) who is animated following the facial expressions, eye and head movements of another person (master) sitting in front of a camera.

While some deepfakes can be created by traditional visual effects or computer graphics approaches, the recent common underlying mechanism for deepfake creation is deep learning models such as auto encoders and generative adversarial networks (GANs), which have been applied widely in the computer vision domain. These models are used to examine facial expressions and movements of a person and synthesize facial images of another person making analogous expressions and movements. The first deepfake video emerged in 2017.

There are also many advantages to this technology, new and good uses for deepfakes are found on a regular basis. Think, for instance, of editing video footage without the need for doing reshoots, or recreating artists that are no longer with us to perform their magic, live. Researchers at Samsung's AI lab in Moscow, for instance, recently managed to transform Da Vinci's Mona Lisa into video. They used deep learning to enable this famous lady to move her head, mouth, and eyes.

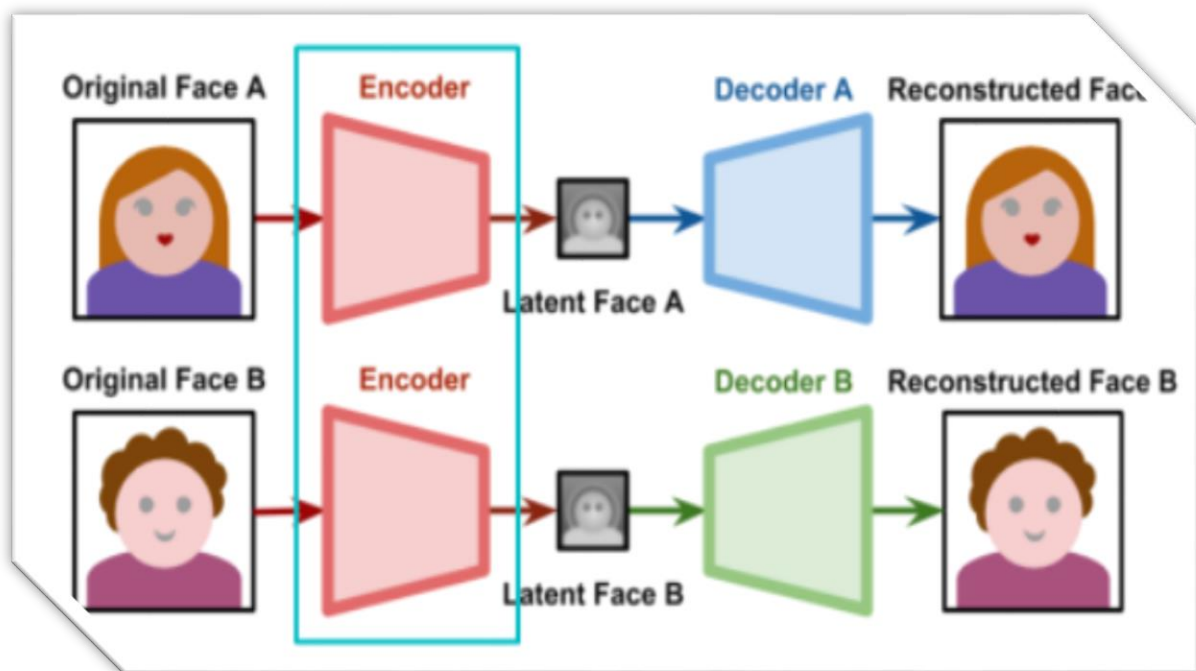
Deepfakes and AI-generated characters can be educational. In Shanghai, during lockdown, Associate Professor Jiang Fei noticed his students' attention dropped during online lessons. To help them focus better he used an anime version of himself to front his teaching. Jiang Fei said: "The enthusiasm of the students in class, and the improvement of the quality of homework have made obvious progress."

Deepfake technology will enable us to experience things that have never existed, or to envision a myriad of future possibilities. Aside from many different potential applications in arts and entertainment, think of all the magic this tech could do in education and healthcare.

Deepfake was also used to produce misleading information and rumours for politicians. In 2018, a fake video for Barack Obama was created to putting words he never uttered. In addition, In the US 2020 election, deepfakes have already been used to manipulate Joe Biden videos showing his tongue out. These harmful uses of deepfakes can have a serious impact on our society and can also result in spreading miss leading information, especially on social media.



### 3. Structure And Working :



#### + Data Collection and Preparation:

Deepfake creation starts with gathering a significant amount of data featuring the target individual. This can include videos, images, or audio recordings from various sources like movies, interviews, or online videos. It collected data and use in face-swapping deepfakes, facial landmarks are detected and aligned to create a standardized dataset.

#### + Deep Learning Architecture:

Deepfake systems typically utilize deep learning architectures, such as generative adversarial networks (GANs), autoencoders, or convolutional neural networks (CNNs).

#### + Training Phase:

During the training phase, the deep learning model is trained on the prepared dataset. The model iteratively learns to generate realistic deepfakes by adjusting its parameters based on feedback. Training involves presenting the model with pairs of

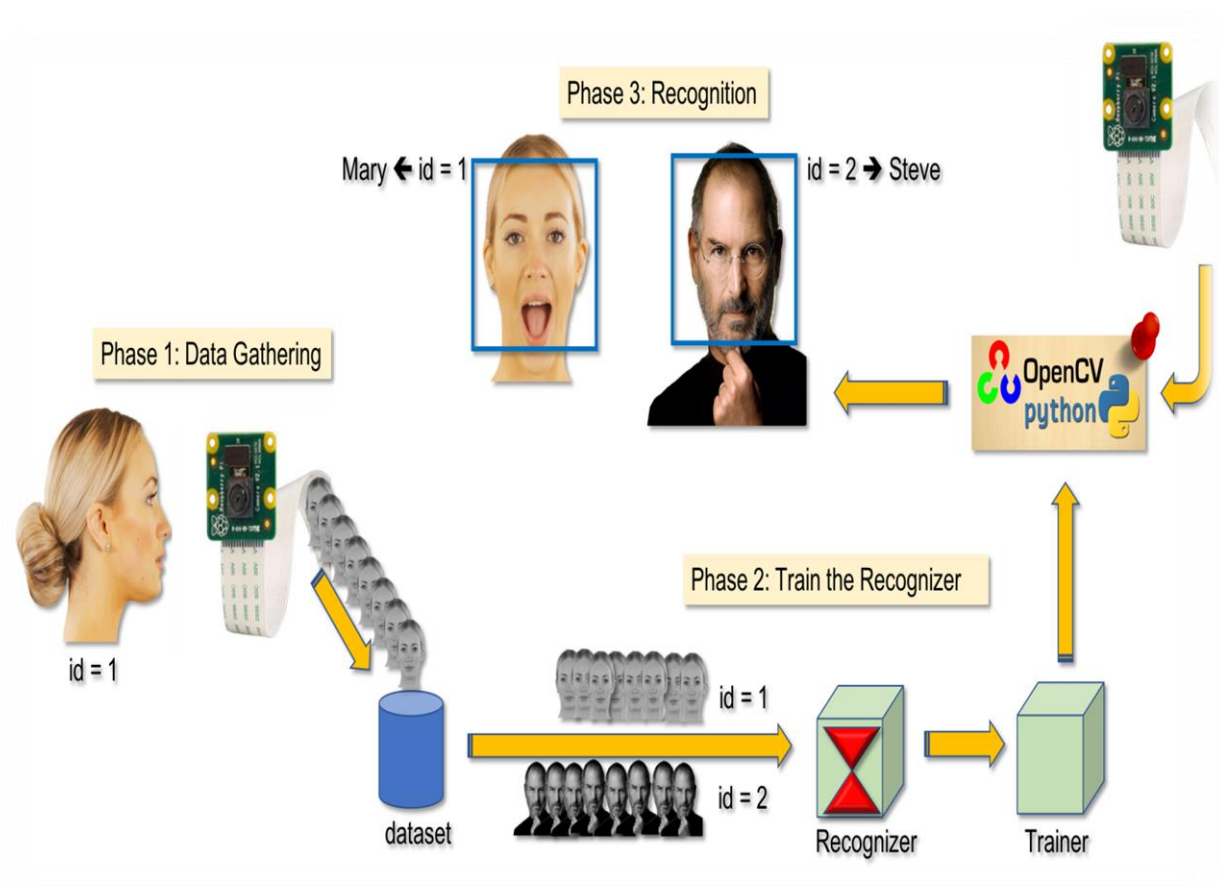
real and fake data. The training process continues until the model achieves a desired level of performance

## + Fine-Tuning and Optimization:

Fine-tuning involves adjusting the model's parameters. Techniques such as regularization, data augmentation, and gradient descent optimization may be employed to enhance the model's capabilities.

## + Generation of Deepfakes:

Once the deep learning model has been trained and optimized, it can be used to generate deepfake content. This may involve various types of manipulations, such as face swapping, facial expression synthesis, voice synthesis, or full-body animation.

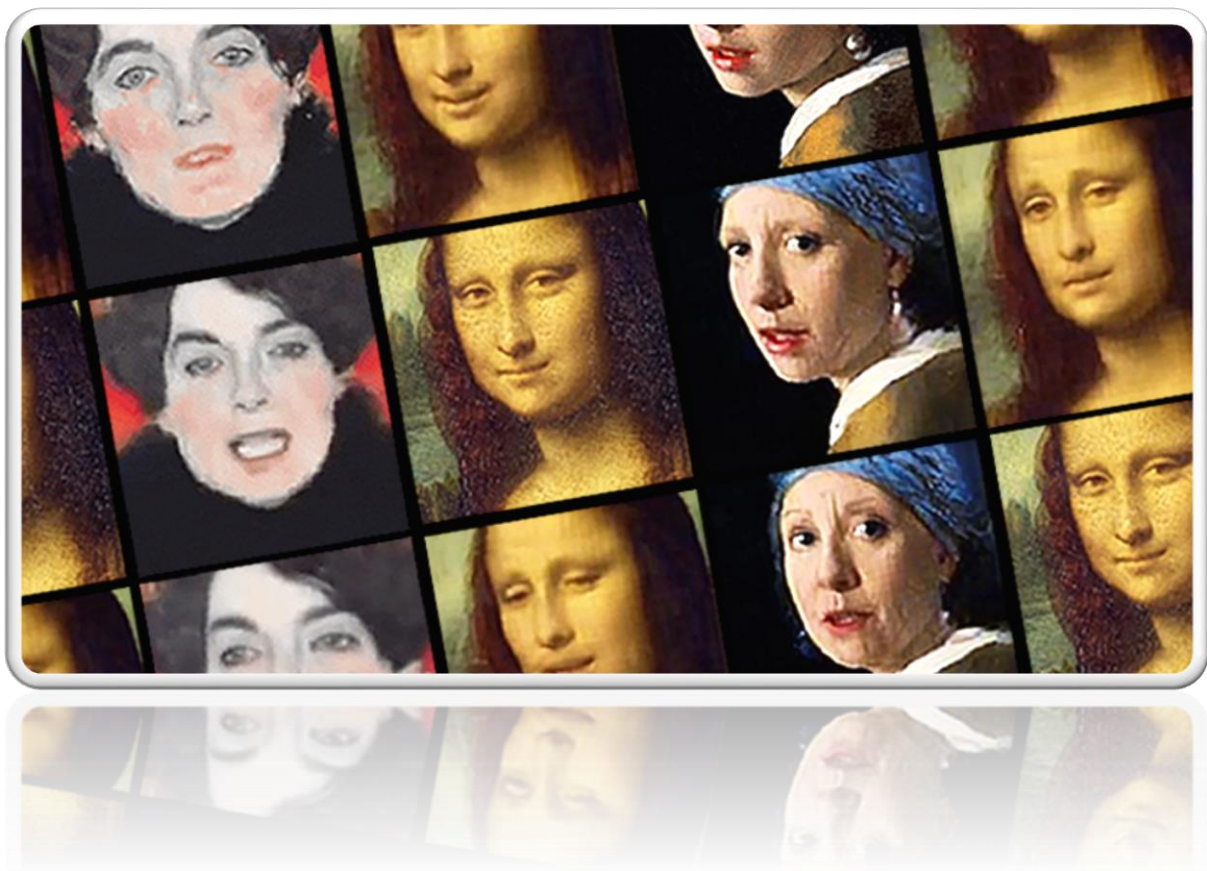


## Post-Processing and Refinement:

After generating the deepfake, post-processing techniques may be applied to further enhance its realism. This may include adjusting lighting conditions, shadows, skin texture, and other visual attributes to ensure that the deepfake appears natural and seamless. Additional processing may also be performed to synchronize facial expressions, lip movements, and audio with the context of the generated content.

## Deployment and Distribution:

Once the deepfake has been generated and refined, it can be deployed or distributed through various channels, such as social media platforms, video sharing websites, or messaging apps. Deepfakes may be used for entertainment purposes, visual effects in movies, digital avatars, or other creative applications.



## 4. How To Detect a Deepfake? :

### ✓ Do details seem blurry or obscure?

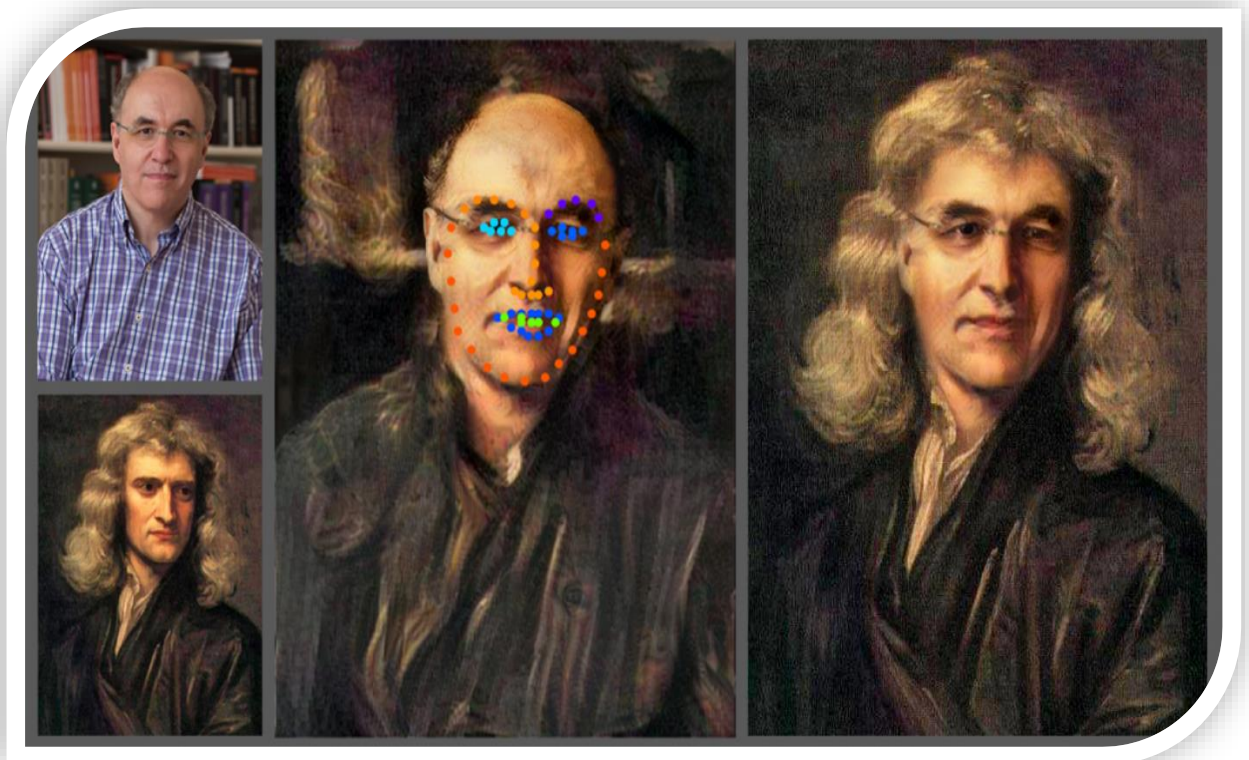
Look for problems with skin or hair, or faces that seem to be blurrier than the environment in which they're positioned. The focus might look unnaturally soft.

### ✓ Does the lighting look unnatural?

Often, deepfake algorithms will retain the lighting of the clips that were used as models for the fake video, which is a poor match for the lighting in the target video.

### ✓ Do the words or sounds not match up with the visual?

The audio might not appear to match the person, especially if the video was faked but the original audio was not as carefully manipulated. Deep Fake may have unnatural audio quality.



### ✓ Check for unnatural movements:

Deepfakes may have artificial movements that are not typical of real people. Look for glitches or distortions in the video that do not match natural movement patterns.

### ✓ Compare with known sources:

Deepfakes are often created by merging two or more existing videos or images. By comparing the deepfake with known sources, you can identify discrepancies.

### ✓ Use Deep Fake detection tools:

Several tools have been developed to help identify deepfakes. These tools analyze various aspects of the media, such as facial expressions, eye movements, and skin textures, to detect if the media is manipulated.

For example, Microsoft's Video Authenticator detects blending boundaries and grayscale elements invisible to the human eye, while Facebook's Reverse Engineering detects fingerprints left by an AI model. While these methods can help detect deep fakes.



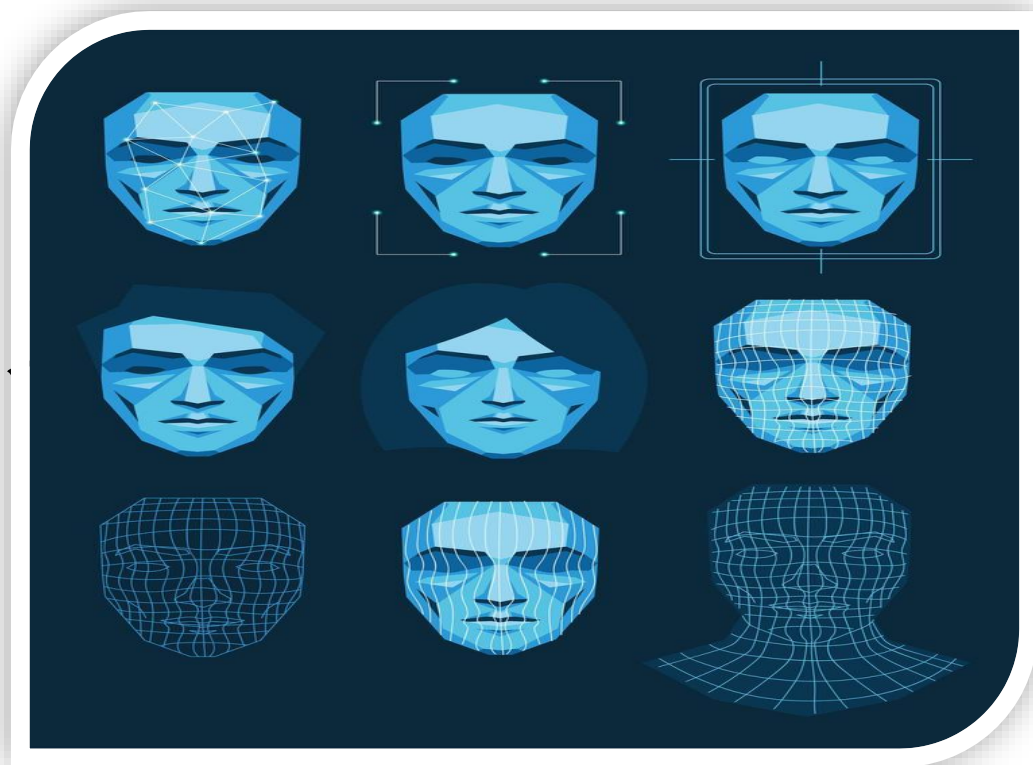
## 5. Types of Deep fake:

### ✓ Face Replacement:

Face replacement is known as face swapping, which includes a photo of one's face (source) which fixing it carefully on the portrait of someone else (target). The identity and attention are on the source. The target is veiled.

### ✓ Facial reconstruction:

Also known as a marionette, facial reconstruction includes managing the characteristics of the face of a target, including the movement of their lips, eyebrows, eyes, and tilting of their head. Re-enactment is not intended for substituting personalities but for distorting expressions of an individual until they seem to say what they are not.



### ✓ Facial Generation:

The production of completely new facial images is a prerequisite. This can be possible with Generative Adversarial Networks, a modern type of profound learning, which operates by opposing two neural networks: the first to produce a picture and the second to determine whether it is a practical outcome.

## ✓ Speech Synthesis:

A relatively recent Deep Fakes sub-set includes creating a speech model of someone who can read the text as the target entity in the same manner, intonation and cadence. Any speech synthesizing device like Modulate.ai allows users to pick a voice of all ages and genders instead of imitating a clear objective.

## 6. Applications of Deep Fake:

### Education:

Deepfakes can assist a teacher in delivering engaging lessons. Also, these lessons would go beyond traditional visual and media formats.

Artificial intelligence-generated synthetic media can bring historical figures to life in the classroom. Thus making lessons more engaging and interactive. A synthetic video of re-enactments or a voice and video of a historical figure will have a greater impact. It might increase engagement and be a more effective learning tool.

With the scale and low cost, the use of synthetic voice and video can also improve success and learning outcomes.



Ex. Deep fake AI can be used to create realistic medical simulations for training healthcare professionals. Simulations could depict various medical conditions and procedures, providing students with valuable hands-on experience in a safe environment



Ex. For instance, a history teacher could use deep fake AI to create a realistic portrayal of Abraham Lincoln delivering the Gettysburg Address, enhancing students' understanding and engagement.



## Art:

Deep fake has the potential to democratize expensive VFX technology. It can also become a powerful tool for independent storytellers at a fraction of the cost.

Deep fakes can be an excellent tool for realistically realizing the primary tenants of comedy or parody. These might be a reflection, stretching, contortion, and appropriation of real events. Also, artificial intelligence-generated synthetic media has great potential. It can open up opportunities in the entertainment industry.

Also, we're seeing a lot of independent creators and You Tubers seizing the opportunity. AI-generated graphics and imagery can speed up game development in the video gaming industry, deep fake technology can be used to create highly realistic character animations by mapping actors' facial expressions onto digital avatars, enhancing immersion and storytelling in games.

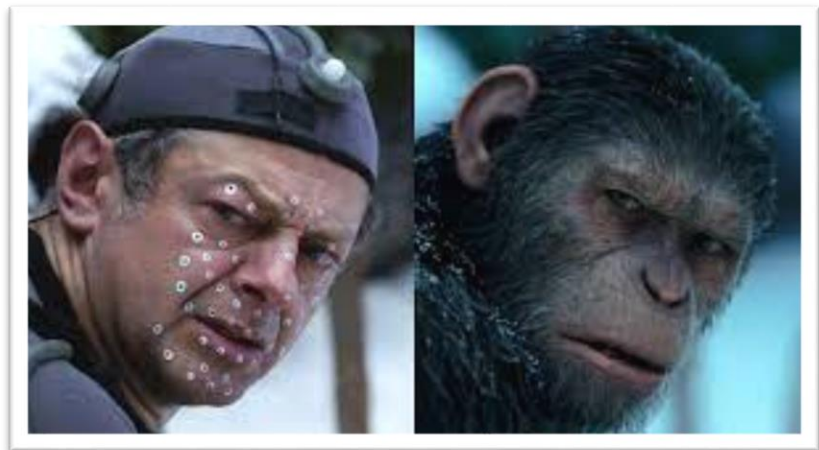
Another good use case for synthetic voice is audio storytelling and book narration. The audio format for the author's book can be created using the author's synthetic voice font. Moreover, businesses can broaden the reach of their content by using synthetic voice-overs of the same actor in different languages.

For Ex. an artist could use deep fake technology to alter famous paintings or create digital portraits with realistic facial expressions and movements.



For instance, recently managed to transform Da Vinci's Mona Lisa into video. They used deep learning to enable this famous lady to move her head, mouth, and eyes.

Allowing actors to transform their appearance or add special effects on screen. This can create a more dynamic and visually engaging experience for audiences.



Imagine a game where characters dynamically adapt their appearance and dialogue based on your choices or actions.

This indie horror game utilizes deepfakes to create a chillingly realistic experience.

## Advertising and Marketing:

Deep fake technology can be used to create highly personalized marketing content. Instead of hiring real-life celebrities or influencers as brand ambassadors, companies can create digital personas using deep fake technology. These virtual ambassadors can be programmed to interact with customers on social media platforms, promoting products and engaging with followers.

Advertisers can use deep fake algorithms to dub or lip-sync existing content, making it more culturally relevant and appealing to diverse audiences.

**Personalized Advertisements:** Deep fake AI can be used to create personalized advertisements. For example, a company could use deep fake technology to insert a customer's face into an ad, demonstrating how a product or service could benefit them personally.

**Celebrity Endorsements:** Deep fake AI could create realistic endorsements featuring celebrities. Brands could use deep fake technology to make it appear as though a celebrity is endorsing their product, even if they didn't actually participate in the advertisement.



Imagine receiving an ad featuring your face.

Deep fakes can personalize ads by allowing viewers to see themselves interacting with the product, making it more relatable.

Samsung used deep fakes to create localized versions of their Galaxy Note 9 launch video featuring celebrities from different countries. This helped them connect with diverse audiences on a deeper level.



## Film Making and Entertainment industry:

The benefits of deepfake technology for the movie industry could be huge when it comes to post-production and reshoots. Since deepfake technology uses an incredible amount of data and footage to recreate a person's image, it could be used by filmmakers to change lines of dialogue without needing to do reshoots. A new line could be written and then recorded by the actor with a camera capturing their movements.

Deepfake technology would then be able to momentarily replace the original performance for the new line. Instead of getting an entire set and crew assembled to change some dialogue, it could all be done with a small team and deepfake technology. The same methods could've been used on *Justice League's* reshoots to avoid Henry Cavil's CGI lip, too.

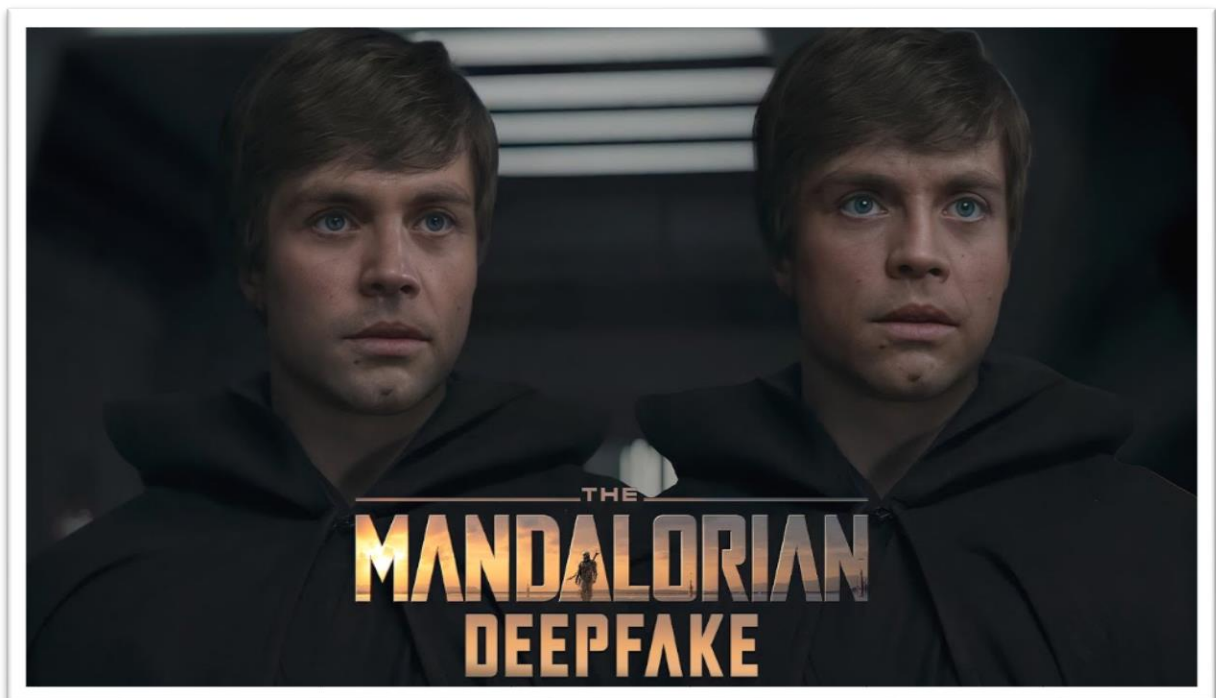
Deepfake AI can automate various post-production tasks in film and television production. For example, it could be used to seamlessly edit out mistakes in scenes or to synchronize dubbed dialogue with actors' lip movements more accurately.

- Popular deepfake creator Shamook took the Spider-man: No Way Home trailer and replaced Tom Holland's face with the original spidey, Tobey Maguire. It's a subtle effect, but executed brilliantly so you can barely tell there's been a change at all.





- Star Wars fandom exploded at the sight of Luke Skywalker in the season two finale of *The Mandalorian*. Once the space dust eventually settled though, viewers were quick to point out what they saw as flaws in the digital recreation of a younger Mark Hamill. Once again, You Tuber Shamook had a go at deep faking a Return of the Jedi-era Luke Skywalker with very impressive results.





## Humanizing Virtual Assistants:

**Humanizing Virtual Assistants:** Deepfake AI can make virtual assistants more human-like in appearance and behavior. For instance, a virtual assistant could be given a realistic human face and voice, enhancing the user experience and making interactions feel more natural and engaging.

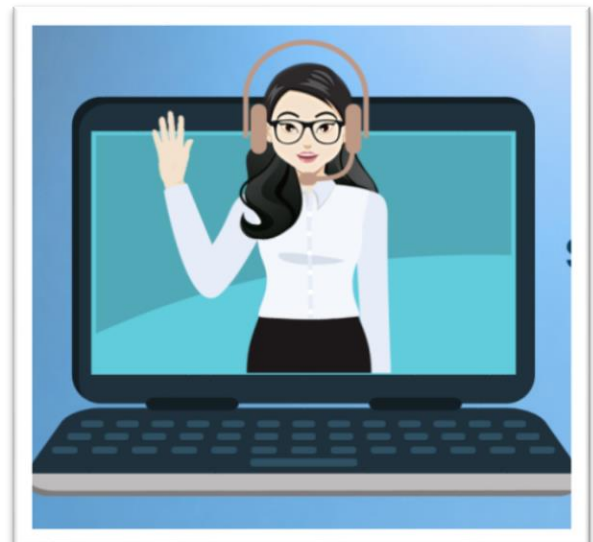
**Custom Avatars:** Deepfake technology can generate personalized avatars for users. For example, a healthcare provider could use deep fake AI to create a virtual avatar that closely resembles a patient, allowing for more personalized and effective communication during telemedicine appointments.





Deepfakes can be used to create entirely new and realistic virtual characters that can interact with real actors in films and games.

Imagine a virtual assistant that adapts its facial expressions and tone of voice based on your emotions.



## 7. Advantages of Deep Fake:

- Deep fake technology, despite its controversial nature, has various advantages for businesses. This AI-based technology is now being used to reshape various industries, from marketing to education and entertainment.

Here are some of the advantages of deep fake technology:

### ❖ Low-Cost video campaigns:

With deep fake technology, marketers can create video campaigns without needing an in-person actor. Instead, they can purchase an actor's identity license and use previous digital recordings of the actor to create a new video.

This can save time and money and also allow for easy edits to be made without the need for reshooting.

### ❖ Hyper-Personalization:

Deepfake technology allows brands to provide customers with more personalized messaging and experiences based on their preferences.

For instance, a brand can alter a model's skin tone in their marketing to better suit a customer's ethnicity or skin color, thus increasing inclusivity and reaching a broader market with their campaigns.

### ❖ Bringing the Deceased Back to Life:

Deepfake technology has also created interactive images of deceased artists and celebrities, enabling audiences to engage with them long after passing.

Examples include the Florida Dali Museum's collaboration with advertising company Goodby, Silverstein & Partners to recreate a digital reanimation of Salvador Dali and Snoop Dogg's music video featuring Tupac.

### ❖ Saving Time and Labor in the Film Industry:

Deepfake technology has the potential to save time and labor in the film industry by automating the face-swapping process currently done manually by



VFX artists. This allows for more efficient and cost-effective production of films and other media.

### ❖ **Educating People in a More Interactive Way:**

Deepfake technology also makes online learning more interactive by generating lecture videos from text-based content or audio narration. Additionally, it can be used to construct artificial voices from historical figures, allowing them to tell their stories/speeches with their own voice.

### ❖ **Engaging with Viewers or Customers:**

Deepfake technology can also engage viewers or customers by providing personalized recommendations and offers to meet their needs.

For example, Reuters has created an AI-generated deepfake person responsible for presenting the sports news summary. In addition, fashion companies are using virtual fitting rooms where customers can deepfake their faces onto virtual models to see how clothes would look on them.

## 8. Disadvantages of Deep Fake:

### ❖ Spreading Misleading News via Politicians:

We are so open to believing what we see or hear in media. And if you see a public figure talking about a topic, you usually would not think if the person is “real” or “fake?”. However, when Deepfake exists, you must. Somebody with bad intentions can easily manipulate the news. This can lead to wars, chaos, and even hunger. The usage area of the Deepfake totally depends on the person. Will you use it for good, or not?

**For example**, in 2018, a deep fake video of former President Barack Obama was created to demonstrate the potential dangers of deep fake technology in spreading false information.

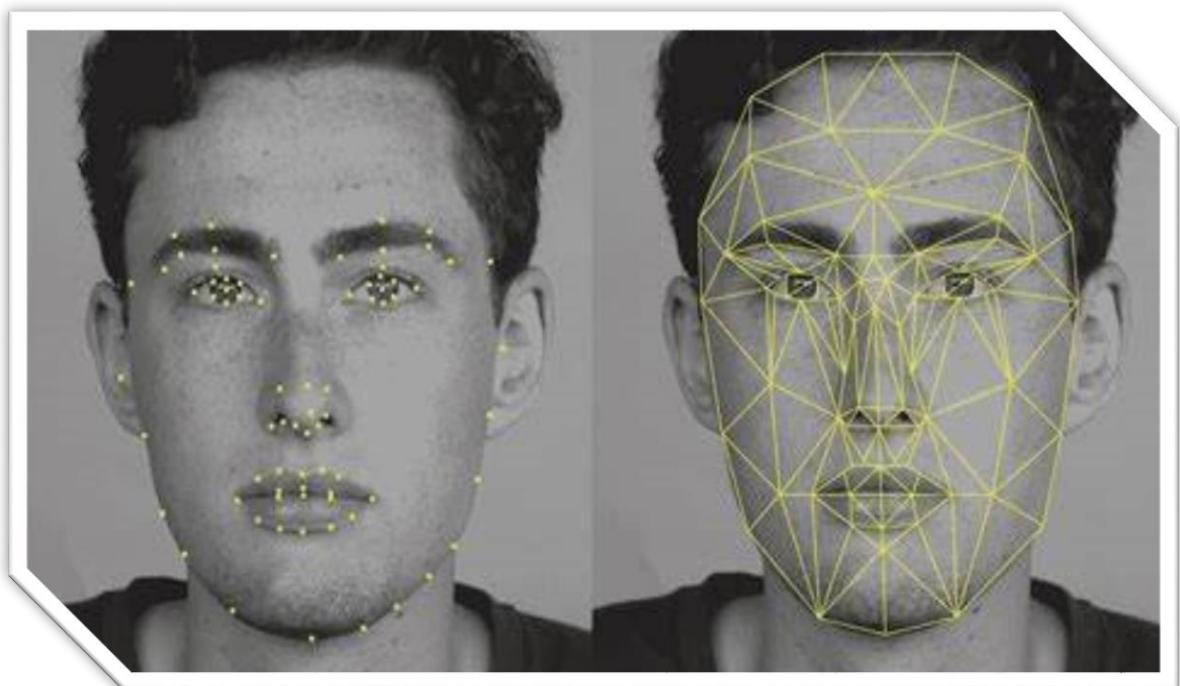


### ❖ Privacy Problems:

We all have social media accounts. We all have Facebook, Instagram, and Twitter. All of us generate tons of data every day. We all share our photos from every angle, with different moods. This may lead to some privacy problems. A Deepfaker

with bad intentions can easily access your photos, take them without permission and use them.

You would not want to see yourself in a fake video without your permission. Unfortunately, the creators of deepfakes have used this technology to exploit and harm people. For example, cybercriminals use deepfakes to commit **identity theft** and online fraud, while individuals fall victim to deepfake-enabled scams. But it is possible. We need a law enforcement. Privacy is the biggest problem of 21st century.



### ❖ Damage reputations:

Moreover, deepfakes can be used for malicious purposes like blackmail and fraud. For instance, a deepfake video can be used to impersonate someone and extort money or sensitive information.

Using deepfakes to create fake adult videos and images of public figures and celebrities can tarnish their reputation and dignity. Deepfake emerges showing a public figure engaging in inappropriate or illegal behaviour, even if it's entirely fabricated, the damage to their reputation can be severe. Even if the video is later debunked or proven to be fake, the damage may already be done

## 9. Future of Deep Fake:

- **Entertainment Industry:** Deep fake technology can revolutionize filmmaking and entertainment by allowing filmmakers to seamlessly recreate historical figures or bring deceased actors back to the screen. This could enable new storytelling possibilities and revive classic performances.
- **Language Translation and Dubbing:** Deep fake technology can be utilized to dub movies and TV shows into different languages more accurately and quickly. It could also be used to improve lip-syncing in dubbed content.
- **Education and Training:** Deep fake technology could enhance educational content by creating realistic simulations for training purposes. For example, medical students could practice surgeries on virtual patients, or language learners could have conversations with virtual native speakers.
- **Accessibility:** Deep fake technology could improve accessibility for individuals with disabilities. For example, it could be used to create realistic sign language interpreters for online videos or to generate personalized avatars for people with speech impairments.
- **Personalized Content Creation:** Deep fake technology could be used to generate personalized content for users based on their preferences and interests. For example, it could create customized workout videos

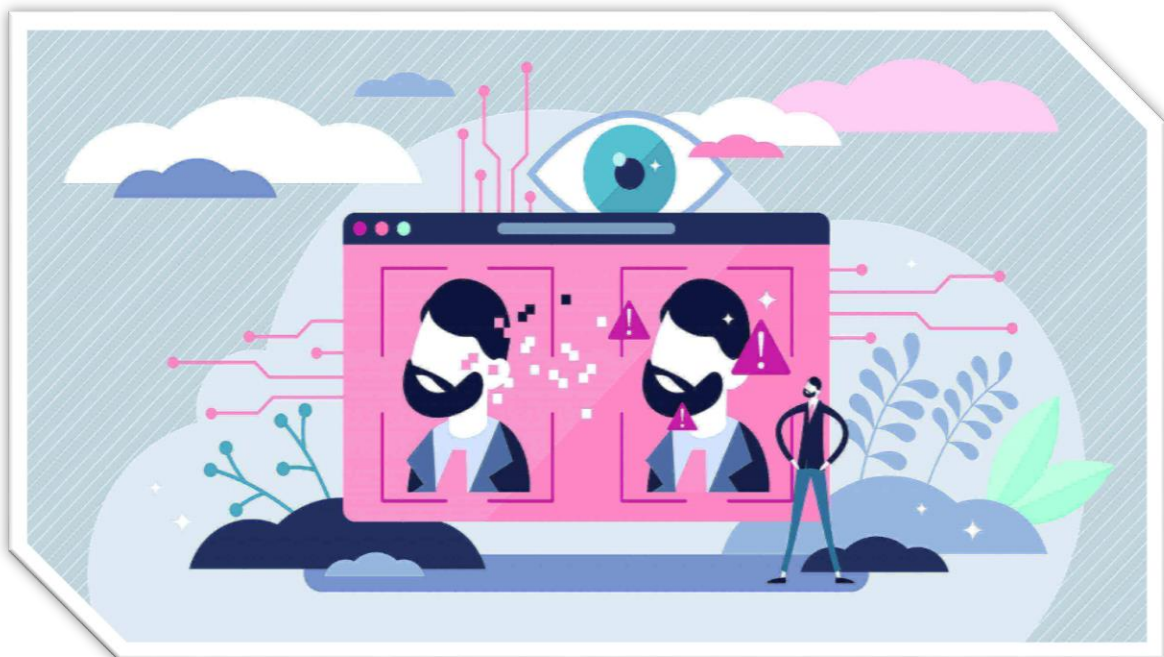
## 10. Conclusion:

In conclusion, deepfakes have the potential to be used for good or bad, and it is up to us to determine how we use this technology.

Deepfakes empower filmmakers, artists, and everyday people to explore new creative possibilities in storytelling, humor, and education.

We must be aware of its potential benefits and drawbacks, and take steps to regulate its use to ensure that it is used ethically and responsibly.

At the same time, we must continue to invest in technology that can detect deepfakes and prevent them from spreading false information or causing harm.



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