SYNTHETIC MEDICAL IMAGE – SCIENCE & TECHNOLOGY

NEWS: The rise of AI-generated synthetic medical images can provide an ethical, scalable, and cost-effective solution to the medical field.

WHAT'S IN THE NEWS?

Synthetic Medical Image:

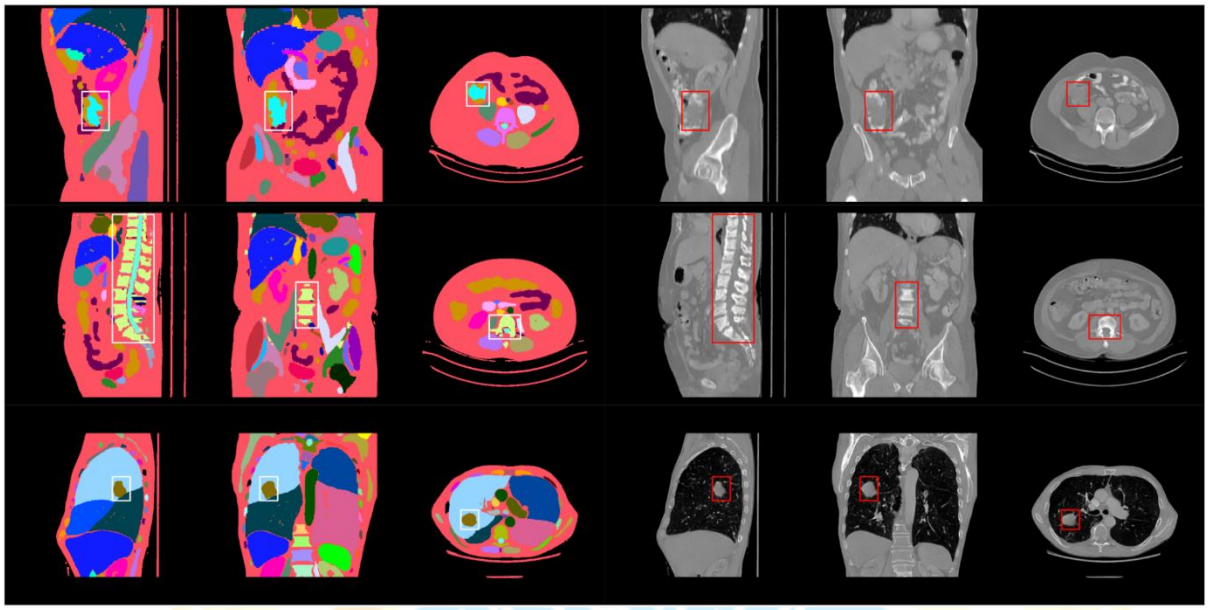
- These images are generated using AI or computer algorithms and are not captured by traditional imaging methods such as MRI, CT scans, or X-rays.
- They are entirely constructed using mathematical models or AI techniques like generative adversarial networks (GANs), diffusion models, and autoencoders.
- In the medical field, synthetic medical images are similarly created, where AI produces new medical scans or radiological images that resemble real ones, but they are not based on actual patient data.

How are these images produced?

- A **variational autoencoder (VAE)** compresses an image into a simpler form called the latent space and then tries to recreate the original image from that compressed version. The process continuously improves by reducing the difference between the real and recreated image.
- **GANs** involve two parts: a generator that creates synthetic images from random data and a discriminator that checks whether the image is real or artificial. Both improve through competition—the generator makes more realistic images, and the discriminator gets better at detecting fakes.
- **Diffusion models** begin with random noise and progressively transform it into a realistic image, using a step-by-step process that refines the noise into something resembling the images it was trained on.

Benefits:

- **Intramodality translation**: Refers to the process of producing synthetic images within the same imaging modality, such as improving or reconstructing MRI scans from other MRI scan data.
- **Intermodality translation:** Refers to the process of producing synthetic images by converting one imaging modality to another like synthesis of CT scans from MRI scans.
- As these images do not involve any patient data, they mitigate privacy issues, allowing for healthy interaction of researchers and healthcare practitioners in the development of AI without the fear of breaching patient privacy.
- Including synthetic medical images also helps in cutting down both the time and cost required to obtain actual medical data.



Challenges:

- Risk of creating deepfakes that could impersonate patients, leading to incorrect diagnoses and fraudulent claims.
- Synthetic images may not capture the subtle nuances of real-world medical data, risking the accuracy of AI diagnoses.
- Over-reliance on synthetic images could blur the lines between reality and fabrication, potentially leading to diagnostic models that misalign with actual patient cases.

Solutions:

- While synthetic medical images offer innovation opportunities, reliance on them poses regulatory and ethical challenges. Human oversight is crucial to maintain the integrity of healthcare decisions.
- Collaboration between clinicians and AI engineers is essential to enhance the quality of synthetic images and ensure they reflect real-world medical complexities.
- The use of synthetic images should be approached with optimism and caution to maximize benefits without undermining real-world healthcare understanding.

Source: https://www.thehindu.com/sci-tech/health/the-rise-of-ai-generated-synthetic-medical-images-a-new-frontier-or-potential-pitfall/article68732520.ece