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EDITED AND REVIEWED BY
Frederic Dufaux,
Université Paris-Saclay, France

*CORRESPONDENCE
Akshay Agarwal,
akagarwal@iiserb.ac.in

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Editorial: Explainable, trustworthy, and responsible AI in image processing

Akshay Agarwal*

Trustworthy BiometraVision Lab, Indian Institute of Science Education and Research Bhopal, Bhopal, India

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Editorial on the Research Topic
Explainable, trustworthy, and responsible AI in image processing

Introduction

The tremendous growth of deep learning models, especially the success of generative AI and foundation models, has led to their deployment in several critical sectors, including biometric recognition, healthcare, language processing, and security. While these models see huge success, the concern around ethics, copyright, and privacy raises serious concerns; therefore, the addressing of the points related to their decision making (explainability of the decision process), trustworthy in dealing the adversaries with explainability (Kumar and Agarwal, 2025), and privacy through responsible AI especially in biometric recognition (Singh et al., 2020), is critical.

The articles featured in this Research Topic illustrate a rapid expansion and dynamic growth of this field of knowledge by presenting novel machine intelligence technologies, including deep learning and generative AI. The research works published aim to advance biometric recognition, including child face recognition and its application in forensics, healthcare, including assessing lung field through developing novel deep learning algorithms for Chest X-Ray and assessing creativity of an individual based on their drawing, and computer vision through advancing video processing, including summarization of videos.

The articles demonstrate groundbreaking research combining advanced signal processing techniques with machine intelligence to address critical challenges in computer vision, face recognition, and healthcare. From creativity assessment to lung profile to de-aging to advancing child face recognition, the articles presented in this editorial emphasize innovation and practical usage.

Face recognition

Apart from security and bias/privacy concerns (Singh et al., 2020; Goswami et al., 2019), one of the prominent concern of current face recognition technology is that they are highly ineffective in processing the face images of child and their vulnerability in performing face

recognition where the age difference between the gallery and probe image is high. Falkenberg et al. counter the limitations of limited exploration of child face recognition by presenting a large-scale database of children's faces by using generative adversarial networks (GANs) and face-age progression (FAP) models to synthesize a realistic dataset referred to as "HDA-SynChildFaces". The resulting HDA-SynChildFaces consists of 1,652 subjects and 188,328 images, each subject being present at various ages and with many different intra-subject variations. As asserted, the EER in the younger age group (4-1 and 7-4) drastically increases compared to the bigger age groups (20+ and 16-13). While the drastic increase has been noticed against deep learning-based face recognition algorithms, ArcFace and MagFace, the increase is not as sharp with a commercial off-the-shelf (COTS) system. Furthermore, there is a significant bias across age groups where the models are highly effective in dealing with male faces compared to female faces, except for age-group 4-1. It was also observed how black and Asian race subjects generally performed worse than white and Latino-Hispanic subjects. On the other hand, Martis et al. advance the forensic system by performing de-aging on the faces and presenting a sketch generation algorithm to increase the accuracy between the sketch and RGB images. For the de-aging, deepfake technology has been used; whereas, for the real-life-like sketch generation, the pix-to-pix approach has been utilized. The results presented for the different age groups from age 20 to 70 in the interval of 10 demonstrate that the generated images have higher image quality in terms of FID, SSIM, and PSNR.

The above Research Topic of articles significantly helps advance face recognition with a perspective of varying age groups, whether aiming to help forensic professionals or lower the performance gap as the age gap between gallery and probe images increases.

Healthcare

Compared to other articles, Yang et al. present a study to advance the healthcare system by automated processing of chest X-ray images. It is asserted that the X-ray is the most widely used primary chest imaging technique as it is widely available, low-cost, has a fast imaging speed, and is easy to acquire. Medical image registration technology is a crucial step and pillar problem in medical image analysis for aligning the source image (moving image) with the target image (fixed image). The work presents a fully automatic three-stage registration pipeline to find the deformation fields of the point-to-point correspondence between the source and target images. Visual differences among the dynamic chest X-Ray (CXR), lung field, and registration images of the source and target images help explain the proposed approach's effectiveness and provide the analysis trustworthiness, especially in medical images. By highlighting the limitation of insufficient dynamic CXR images, the article demands that researchers collect more dynamic CXR images.

Computer vision

Creativity assessment evaluates an individual's creative thinking abilities and capacity to generate novel and valuable ideas. Panfilova et al. performed a benchmark study to identify the creativity of different individuals based on their drawings. The authors have used multiple deep convolutional neural networks, including AlexNet, GoogLeNet, and MobileNet-V2. Further, to ensure the assessment is trustworthy, the work performed the Grad-CAM analysis of models by checking the most relevant features in drawings that influence the model's prediction. On the other hand, in this vast Research Topic of editorial, Tsigos et al. presented a video summarization algorithm by looking at the pain of understanding and even seeing the large video. Traditionally, this laborious and time-consuming task requires a professional video editor to watch the entire content and decide the parts of it that should be included in the summary. The work adapts the LIME method by operating it on sequences of video frames rather than on a single frame/image. To ensure the generated summary is explainable, authors integrate fragment- and object-level explanation methods into a framework for multi-granular explanation of video summarization. In particular, our framework can provide fragment-level explanations that show the video's temporal pieces that influenced the summarizer's decisions the most.

The above Research Topic of articles significantly helps advance computer vision algorithms by presenting novel video processing algorithms and image processing approaches to assess creativity, which can later be used to diagnose illnesses. The articles also show future directions in improving the field, such as using vision-language models for a textual description of the images.

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Conflict of interest

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Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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