NAIST® Research Highlights

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Diminished reality in action: Left panel is the original image, right panel is the resulting image with signpost removed via the new diminished reality process.

Image processing

Seamlessly removing objects from images

New state-of-the-art image processing methods may allow objects to be removed from still photography — and even video

Image processing is no longer just about removing cellulite from celebrities or lens flare from lakes. Beefed-up computing power, combined with increasingly sophisticated image processing techniques, has made it possible to remove unwanted objects from video in real-time. "Real-time object removal allows us to simulate various scenarios, such as furniture arrangement and city planning, using real video images," notes Norihiko Kawai.

"Diminished reality methods have not been deeply investigated – there are still many issues to be addressed."

Kawai, along with colleagues from the Graduate School of Information Science at NAIST, have used two approaches for the removal of objects from the foreground of an image: 'in-painting' for static images and, more recently, 'diminished reality' for video images.

Diminished reality refers to the real-time removal of objects from videos. It is the opposite of augmented reality: the addition of computer-generated objects to videos in real-time. "Whilst augmented reality techniques have been widely developed, diminished reality methods have not been deeply investigated – there are still many issues to be addressed," explains Kawai.

In response, Kawai and his colleagues decided to build on the success of image in-painting — an established technique where an object is removed from the image foreground, with the empty space being filled-in using an actual or realistic background texture — and apply it to diminished reality.

His team developed a diminished reality process based on image in-painting, but a sophisticated one that uses multiple two-dimensional planes to approximate a three-dimensional background. First the scene to be modified is analysed and a key frame, with the object to be removed, identified and an appropriate mask is fitted. After analysis, two processes are run concurrently: image in-painting for the one key frame, and real-time overlay of that in-painted texture for subsequent frames.

The results have been impressive, allowing for an almost seamless removal of objects (see figure). Without the panel on the left of the image in the figure above, it is unlikely the viewer would know there had ever been a signpost at the beginning of the footpath. Surprisingly, the computational load of this powerful method is comparable to related techniques.

Further complications lie ahead for this technique, such as removing target objects that are in motion, and dealing with increasingly complex background textures. However, Kawai looks forward to embracing the challenge of addressing these issues: "Adding virtual objects and removing real objects from video enriches our interactions with media for both entertainment and practical use," he says.

Reference

1. Kawai, N., Sato, T. & Yokoya, N. From image inpainting to diminished reality. In *Virtual, Augmented and Mixed Reality. Designing and Developing Virtual and Augmented Environments*. Lecture Notes in Computer Science **8525,** 363–374 (2014).

More information about the group's research can be found at Norihiko Kawai's webpage:
http://yokoya.naist.jp/~norihi-k/research-e.html