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Latency Measurement Tool Improves Augmented Reality Systems

LED-based Device Provides Time Stamps in Mixed Spectral Bands

Minimizing the lag between real-time imagery and imagery superimposed upon it is key to creating convincing augmented reality experiences and a new tool developed by Disney Research provides an accurate means of measuring that latency.

The LED-based measurement device is designed to work in multiple spectral bands, a crucial capability when working with augmented reality systems that use imagery from cameras operating in different spectral bands. Infrared-based tracking systems are an example of such a system.

"Reducing latency is particularly important when superimposing imagery over a real-world scene, as in dynamic projector-camera systems, or procams," said Markus Gross, vice president at Disney Research. "You can't expect to reduce or eliminate latency if you can't reliably measure it. That's why this work by our team is significant."

Knowing the amount of latency makes it possible to use prediction and extrapolation methods to bring the superimposed imagery into synchronization with the real-time images, said Anselm Grundhöfer, principal research engineer at Disney Research.

Anselm led the team that designed the latency measurement device. The researchers presented their work Sept. 16 at the IEEE International Symposium on Mixed and Augmented Reality in Merida, Mexico.

The device features three rows of 16 white and infrared (IR) LED pairs, which display the time as a gray code. Gray code is a binary numeral system in which two successive values differ by only one bit, which eliminates the possibility that a transitional state between two values in normal binary code will be mistaken as the actual value.

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By displaying the time in both visible light and IR light, the clock can simultaneously provide time stamps for cameras operating in each spectral band.

Grundhöfer's team demonstrated that the clock could measure the overall end-to-end latency of camera-based augmented reality systems with an accuracy below one millisecond.

"The system could be easily configured for different accuracy requirements and spectral sensitivities, ranging from the ultraviolet up to the mid-infrared thermal spectrum, as long as LEDs are available in the desired range," Grundhöfer said.

The research team also included Gerhard Röthlin and Jan Wezel of Disney Research; Markus Billeter, a former Disney intern who now is a researcher/GPU expert at Chalmers University of Technology, and Daisuke Iwai, associate professor of engineering at Osaka University.

For more information, visit the project web site http://www.disneyresearch.com/a-led-based-ir-rgb/end-to-end-latency-measurement-device/.

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About Disney Research

Disney Research is a network of research laboratories supporting The Walt Disney Company. Its purpose is to pursue scientific and technological innovation to advance the company's broad media and entertainment efforts. Vice Presidents Jessica Hodgins and Markus Gross manage Disney Research facilities in Los Angeles, Pittsburgh and Zürich, and work closely with the Pixar and ILM research groups in the San Francisco Bay Area. Research topics include computer graphics, animation, video processing, computer vision, robotics, wireless & mobile computing, human-computer interaction, displays, behavioral economics, and machine learning.

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