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## Video Frame Synchronization for A Federation of Projector Using Camera Feedback

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### CONTACT

Ben Chu  
ben.chu@uci.edu  
tel: .



### INVENTORS

- » Amiri, Kiarash
- » El Zarki, Magda S.
- » Kurdahi, Fadi J.
- » Majumder, Aditi
- » Yang, Shih-Hsien

### OTHER INFORMATION

### CATEGORIZED AS

- » **Communications**
  - » Internet
  - » Networking
  - » Optical
  - » Wireless
- » **Computer**
  - » Hardware
  - » Software

## BRIEF DESCRIPTION

The technology is a video frame synchronization technique for multiple projector displays. It features a technique based on camera feedback and works by adjusting frame display times between projectors. It allows for collaborative displays between resource limited devices.

## FULL DESCRIPTION

This invention is a camera feedback based video frame synchronization technique for multiple projector devices that are positioned in tiled or superimposed setups. The technique can be used to improve viewing experience for the user by allowing collaboration between resource limited devices.

The technique uses images captured from the projection area of multiple projectors to adjust the frame display time of each projector for a synchronized playback.

Prior to starting the video playback, a synchronization period occurs. During this initial period, each projector displays patterns that indicate the frame numbers of the projector. Images captured by a single or multiple cameras connected to the projectors are used to calculate the offset between frame display times of the different projectors. Based on the information from this setup, whether it is superimposed or tiled, and if the purpose is to increase the brightness, frame rate or resolution, the display time for the frame buffer of each projector is adjusted. This process allows for the aggregation of resources on mobile projector systems.

Pico projectors are a form of ultra-portable projectors that implement an image projector into a handheld device. In light of current trends towards all-in-one portable devices and the ever increasing ease of access to digital media, a pico projector integrated into a hand held device, such as a smartphone, is an appealing idea to consumers who are concerned with media sharing.

However, there are issues with the realization of such a product. The longevity, portability, and power efficiency of pico projectors come at the cost of severely reduced image quality. This poses a serious limitation when coupled with recent technology advances in the quality of video resolution and capture devices. Unlike any other alternate display technology, pico projectors have a distinctive advantage -- the image displayed from multiple pico projectors can be overlaid or tiled to create a dramatically improved display in both brightness and resolution. This "overlay" ability enables a group of multiple pico projectors to offer the unique ability to create a higher quality display than is possible from a single pico projector.

Earlier approaches to implementation of multi-projector displays consider multiple projectors in a LAN setting, where the machines driving the projectors are usually dedicated to the display without much CPU or network load. The most common applications on such displays are related to interactive rendering for visualization, simulation, and training that do not demand a hard synchronization for video. Loose synchronization achieved via NTP (network time protocol) was used in such prior works. NTP provides reasonable synchronization in a LAN setting, but synchronization becomes an issue in the case of a group of projector-embedded mobile devices on a heavily congested mobile network with non-deterministic delays. This technology implements multi-projector displays using a more efficient visual-feedback synchronization method that avoids these network congestion issues, allowing for collaborative display between resource-limited devices.

## SUGGESTED USES

- » Video sharing using handheld projectors
- » Enhanced resolution setup for handheld or pico projectors

## ADVANTAGES

- » Uses visual feedback for video synchronization instead of network-hogging message exchange
- » Potentially used without connection to a wireless network

## PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,218,061	12/22/2015	2011-860

## LEAD INVENTOR

- » **Engineering**
  - » Engineering
- » **Imaging**
  - » 3D/Immersive
  - » Software
- » **Sensors & Instrumentation**
  - » Position sensors

## RELATED CASES

2011-860-0

## Aditi Majumder

Department of Computer Science  
Donald Bren School of Information and Computer Sciences  
University of California, Irvine

<https://www.eng.uci.edu/users/aditi-majumder>

<http://www.ics.uci.edu/~majumder/>

## RELATED MATERIALS

» Collaborative Video Playback on a Federation of Tiled Mobile Projectors enabled by Visual Feedback, K. Amiri, S. Yang, F. Kurdahi, M. El Zarki, A. Majumder, ACM Multimedia Systems, 2012 - 02/13/2012

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Distributed Scalable Interaction Paradigm for Multi-User Interaction Across Tiled Multi-Displays
- ▶ A Projector With Enhanced Resolution Via Optical Pixel Sharing
- ▶ Tracking Diet And Nutrition with a Wearable Bio-lot
- ▶ Cognitive Power Management For Memory-Dominated Wireless Communication Systems

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Applied Innovation

5270 California Avenue / Irvine, CA  
92697-7700 / Tel: 949.824.2683



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