Mountable Dynamic Range Enhancer for Digital Cameras

Cheng-Han Wu and Po-Nan Li
Department of Electrical Engineering, Stanford University

Motivation

High dynamic scenes are one of the most challenging scenarios encountered by photographers. Inspired by back card technique, we propose to design and implement a programmable liquid crystal (LC) based filter. Through real-time modulation in front of lenses we can achieve HDR as well as polarization filtering effect in one shot.



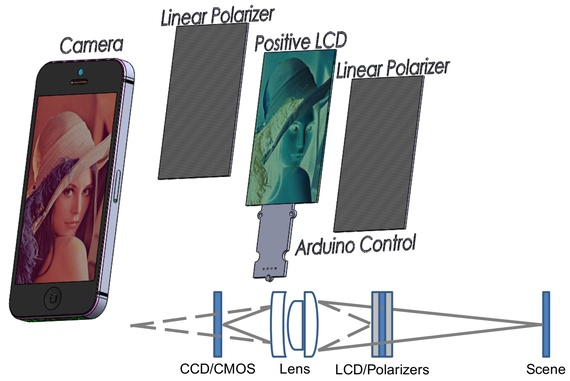
Photography: "Black card" technique



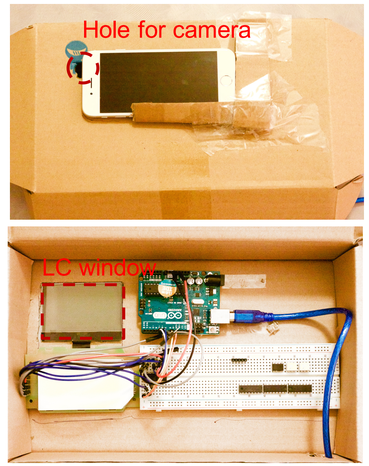
Comparison: Before/after black card.

New Technique

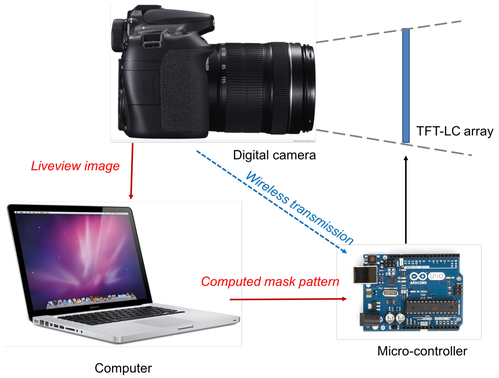
We have designed and implemented a device that can help cameras capture single shot HDR photo without further post-processing. Mounted in front of the lens, this device can locally modulate incident light intensity, thus enhancing the photo dynamically in real-time.



Concept and Build: A naturally white (positive) LCD is used so it will be transparent when not modulated. When a pixel is "on," the intensity will be attenuated.



Prototype: A cardboard hosting the LC glass and microcontroller.

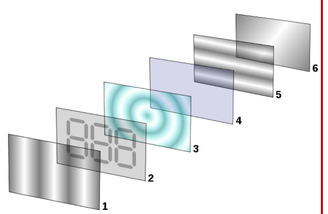


System Schematics: Currently a PC is needed for computation; in the future it can be done solely on a micro-controller.

Related Work

LCD

Liquid crystals are optical-active. By using with two linear polarizers on its two sides, a LC glass can serve as a light intensity modulator.



HDR Photography

Conventional HDR takes multiple photos to get an HDR image.



Post-processing

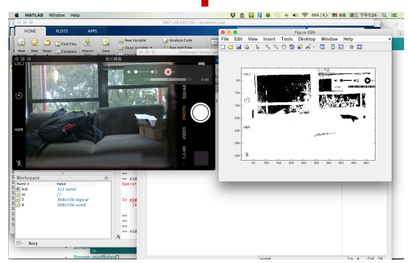


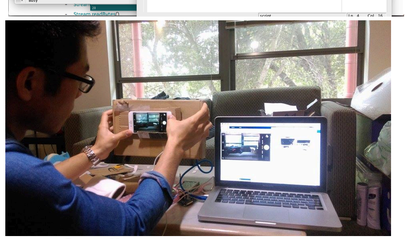
Experimental Results



Our first "HDR" image: the left part was attenuated, while the right part was not.





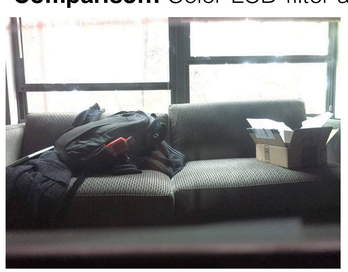


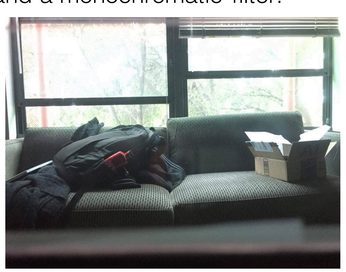
System Configuration: Instantaneous control over LCDusing computer generated inverse mask.





Comparison: Color LCD filter and a monochromatic filter.





Comparison: A mask produced provides more details in the overexposed area.