Focus Cue Enabled Head-Mounted Display via Microlens Array

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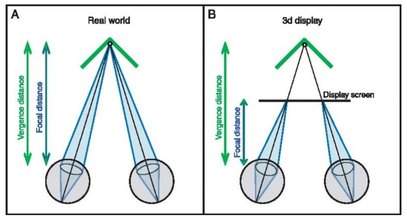
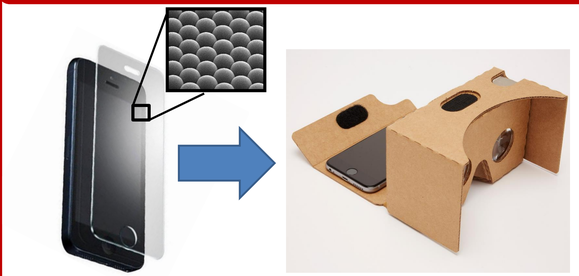
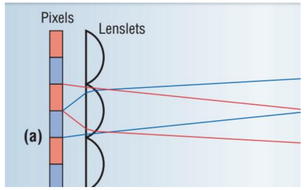
Motivation

With typical head-mounted displays (HMDs) our eyes will verge to the virtual image plane, but accommodate to the screen, causing visual fatigue. Adding a microlens array to the system creates a light field that allows for natural accommodation, removing discomfort.



Project Goal



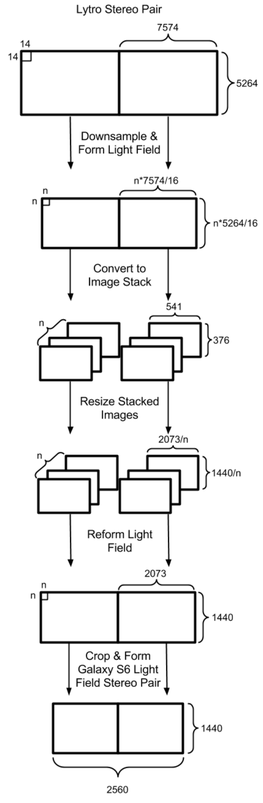


Google Cardboard: Stereo Images → Depth And Focus Cues ← Microlens Array: Viewing Zones

To design this, Micolens array specifications were calculated to ensure all viewing zones are mapped to the eye and image processing was done to place the correct image into each viewing zone.

Image Processing

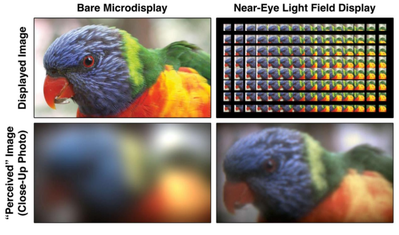
Pipeline



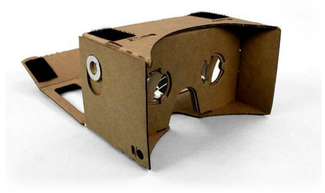
Results

Existing Head Mounted Displays

MicroLens Array HMD

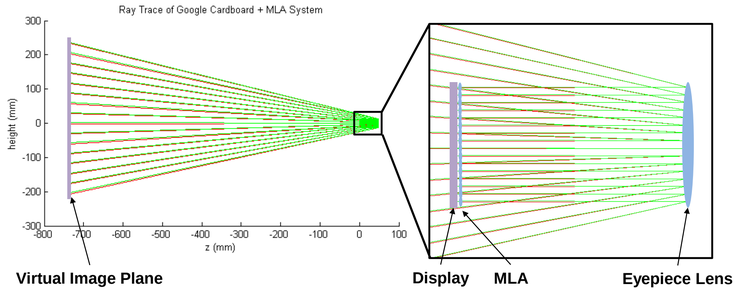


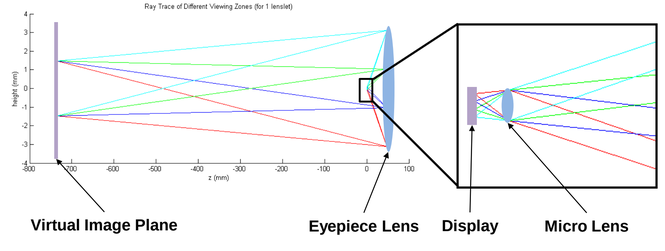
Google Cardboard



Nvidia research has created a microlens array-based HMD that addressed the vergence-accommodation conflict using near eye light field displays

Optical System Design





Results

Optical Parameters

Eyepiece Diameter	37 mm
Eyepiece Focal Length	50 mm
Screen to MLA dist	1 mm
MLA to Eyepiece dist	47 mm
Pixels Per Lenslet	4 pixels
MLA Focal Length	979.2 µm
Spatial Resolution	2.93 mm
Number Viewing Zones	4

Displayed Image

References

[1] Lanman, Douglas, and David Luebke. "Near-eye light field displays." *ACM Transactions on Graphics (TOG)* 32.6 (2013): 220.
[2] Perlin, Ken, Salvatore Paxia, and Joel S. Kollin. "An Autostereoscopic Display." *Proceedings of the 27th annual conference on Computer graphics and interactive techniques*. ACM Press/Addison-Wesley Publishing Co., 2000.
[3] Huang, Fu-Chung, David Luebke, and Gordon Wetzstein. "The Light Field Stereoscope." *ACM SIGGRAPH Emerging Technologies* (2015): 24.
[4] Dodgson, N. "Autostereoscopic 3D Displays" *IEEE Computer Society, August, 2005 0018-9162*
[5] Schwerdtner. A, Heidrich, H "The Dresden 3D Display" SPIE's Stereoscopic Displays and Applications IX Vol. 3295, 0277-786X
[6] Maimone, A, Wetzstein, G, Hirsch, M.,Lanman, D. Raskar, R."Focus 3D: Compressive Accomodation Display" ACM Transactions on Graphics.