The Future of Human Vision

Preferential Augmentation Using GPUs


Wikimedia Foundation


Nearsightedness Simulation


Diplopia Simulation


Early Stage Macular Degeneration Simulation


Protanopia Simulation

Current Situation

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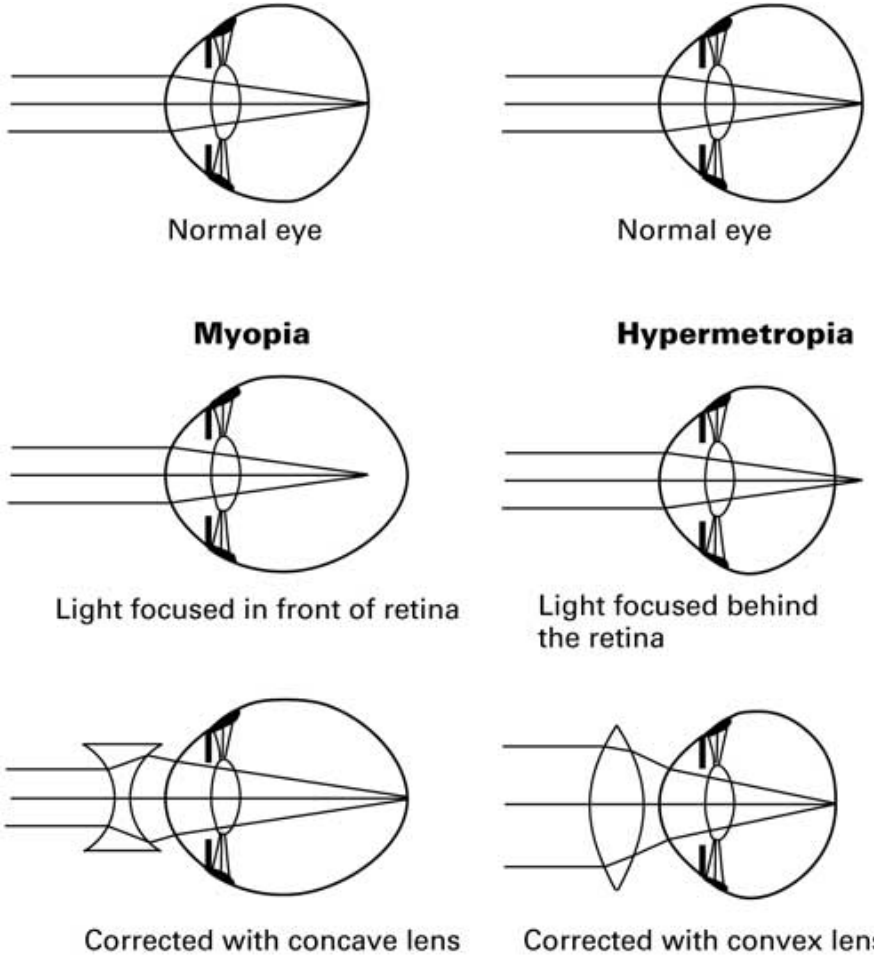
- Traditional glasses limited (Snell's Law)



Patient.co.uk

The Idea

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- Broader class of transformations
- Specific Cases
  - Colorblindness
  - Macular degeneration

Computer Mediated Vision

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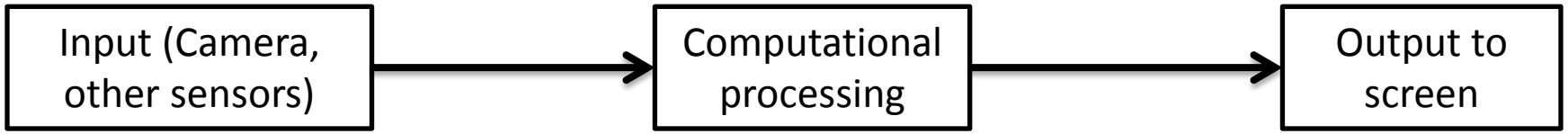

OpenGL ES Pipeline

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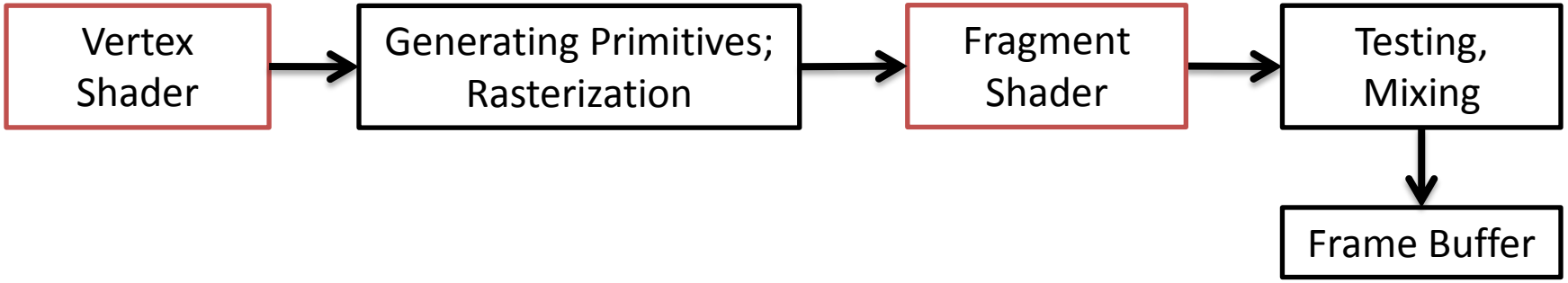

Current Medium

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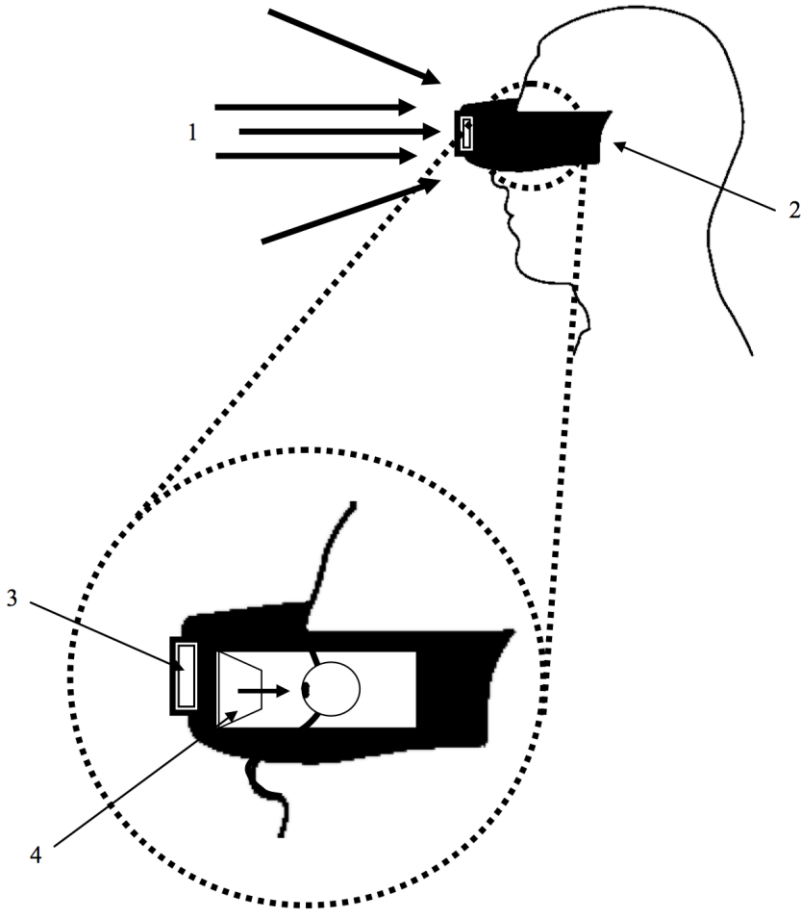

Reality Hacker (Google Play)

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Colorblindness

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- LMS (wavelength) color space
- Daltonization

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} l \\ m \\ s \end{pmatrix} = \begin{pmatrix} l' \\ m' \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 1-\alpha & 0 & \alpha \\ 0 & 1-\alpha & \alpha \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} l \\ m \\ s \end{pmatrix} = \begin{pmatrix} l'' \\ m'' \\ 0 \end{pmatrix}$$

Colorblindness

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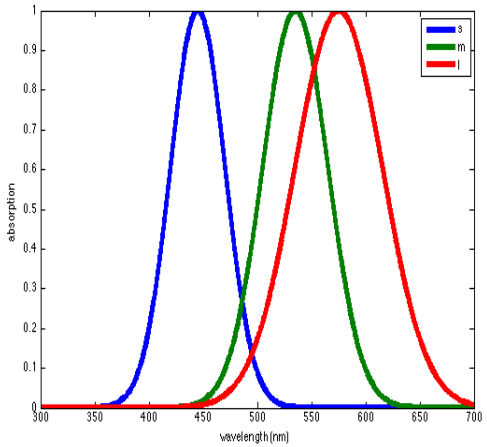

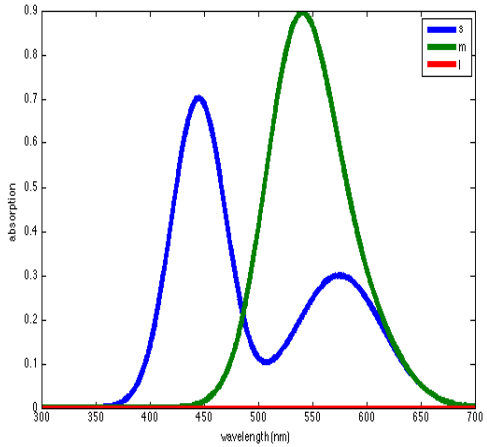

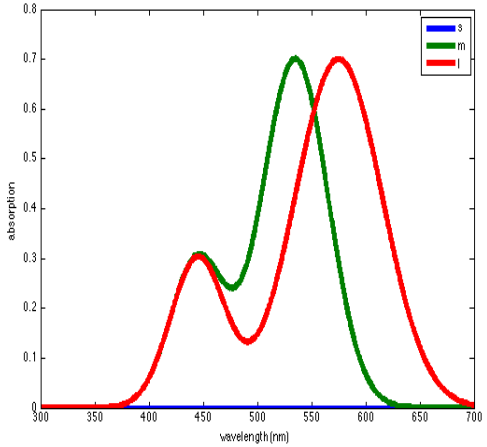

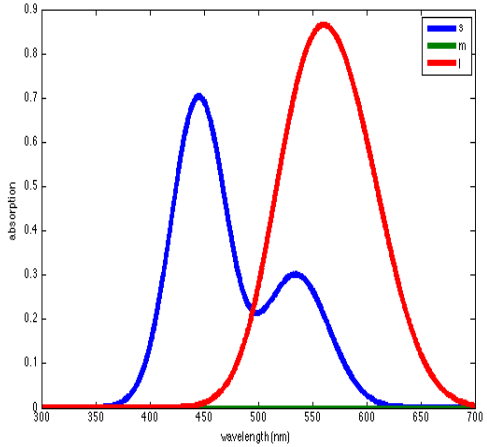

Colorblindness

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```
precision mediump float;
varying vec2 textureCoordinate;
uniform sampler2D texture1;
const vec2 gcoeff = vec2(-0.255, 1.255);
const vec3 bcoeff = vec3(0.30333, -0.545, 1.2417);
void main() {
        vec4 tex = texture2D( texture1, textureCoordinate );
        float g2 =  dot(tex.rg, gcoeff);
        float b2 =  dot(tex.rgb, bcoeff);
        gl_FragColor = vec4(tex.r, g2, b2, tex.a);
};
```

Colorblindness

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Colorblindness

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Colorblindness

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Macular Degeneration

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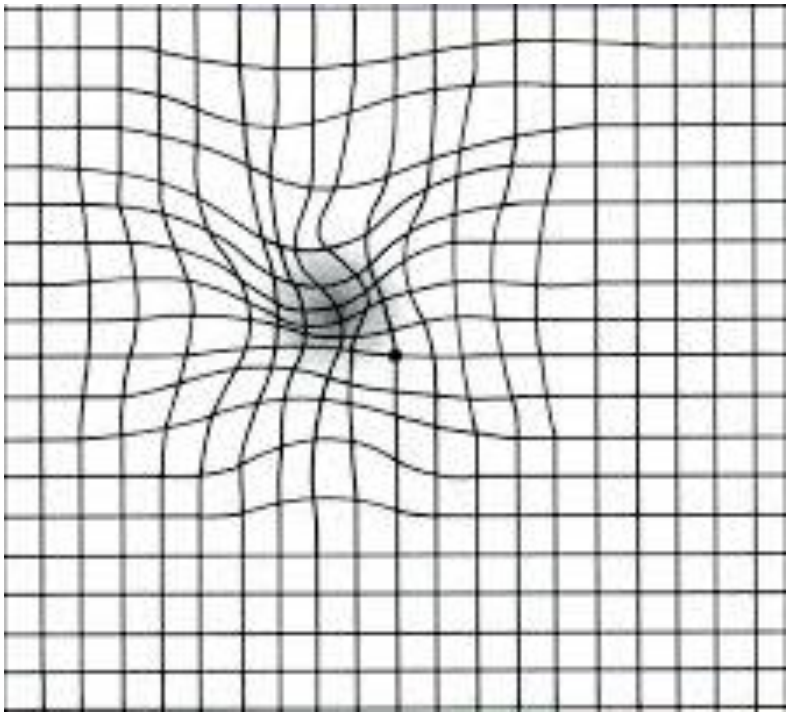
- Patient specific distortions
- Amsler grid diagnostics



Macular Degeneration

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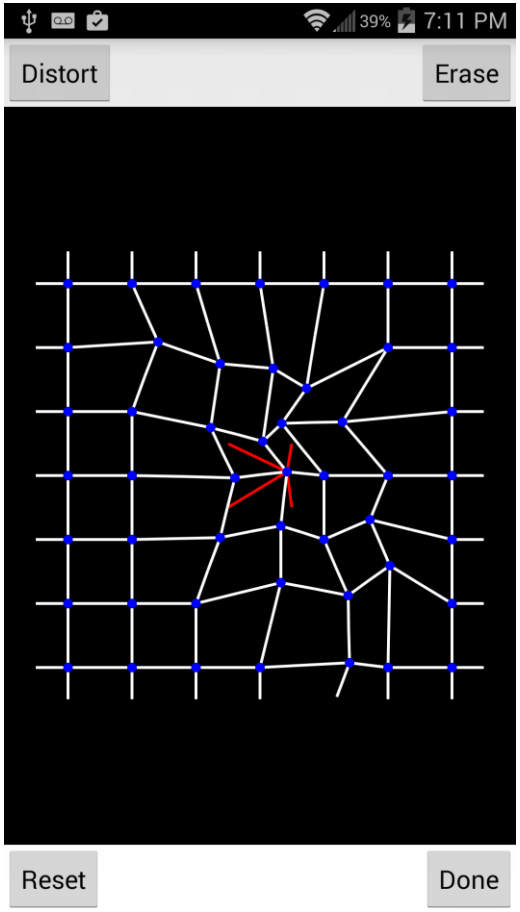

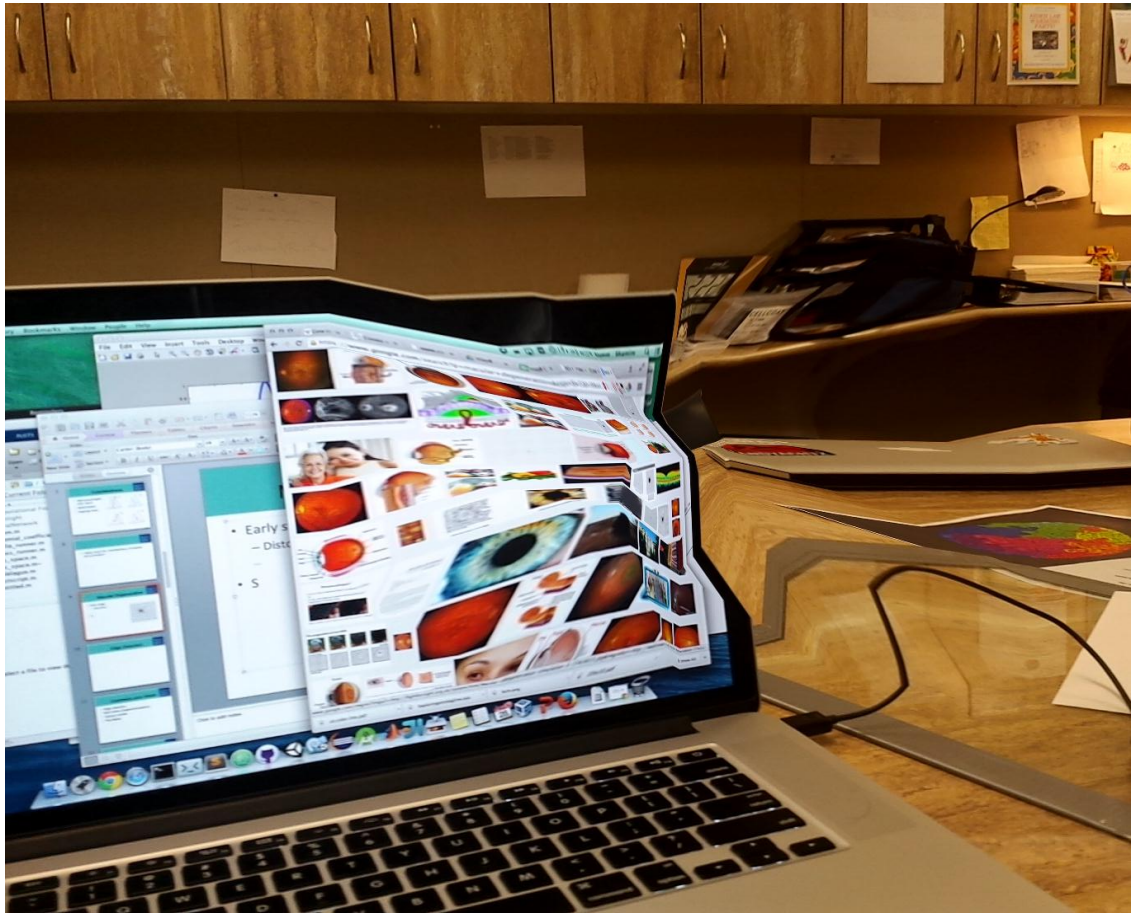

Customize your World

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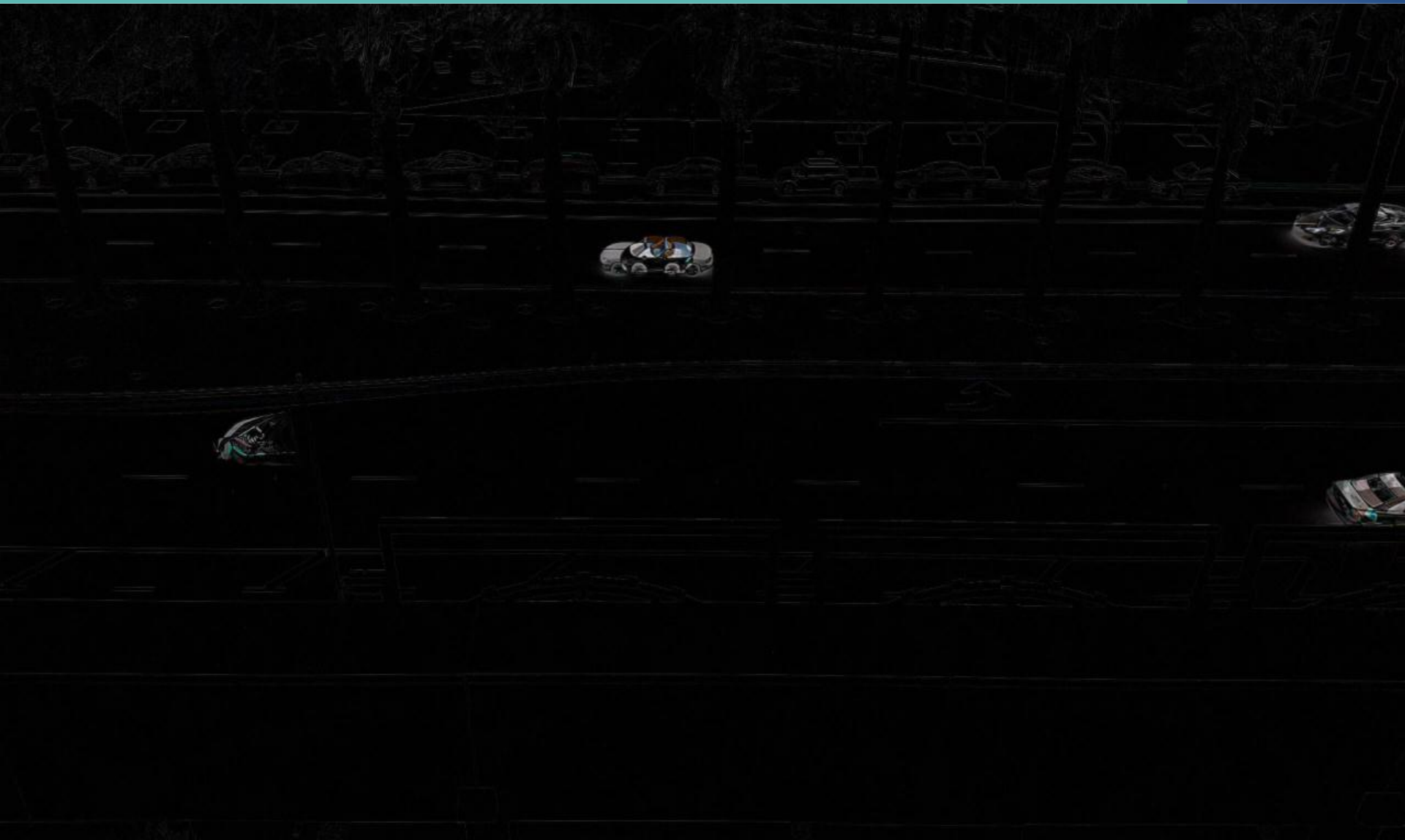

C^2 – Impossible Colors

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- Simple model for each eye

$$C = \left\{ x \in R^3 : 0 \leq x \cdot \hat{e_i} \leq 1 \right\}$$

- Retinal Rivalry
  - Neural experience in C^2
  - Pseudo C^2 ~ GIFs
  - Perception variation
  - Alternative Correction

Performance

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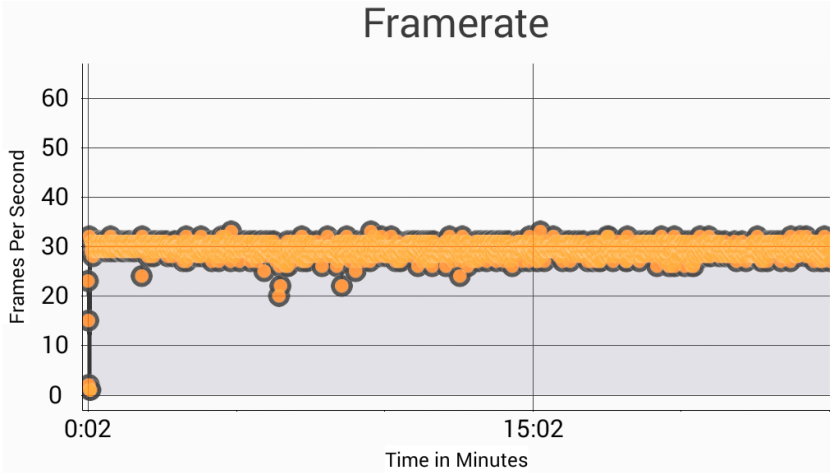
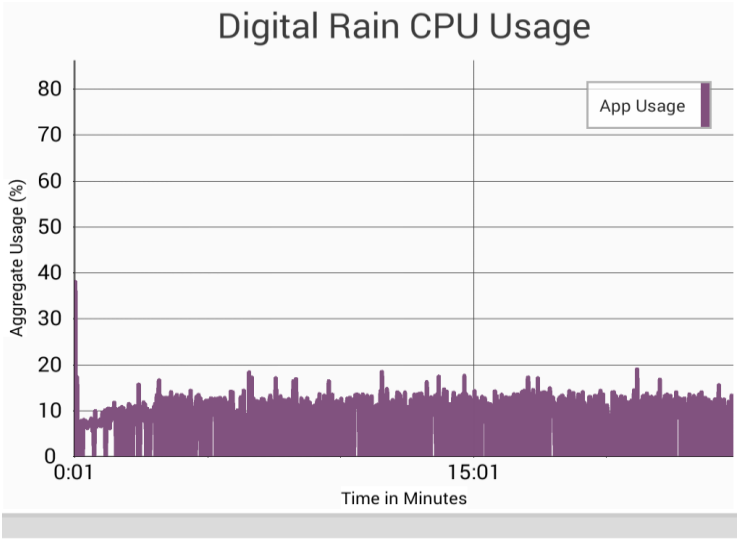
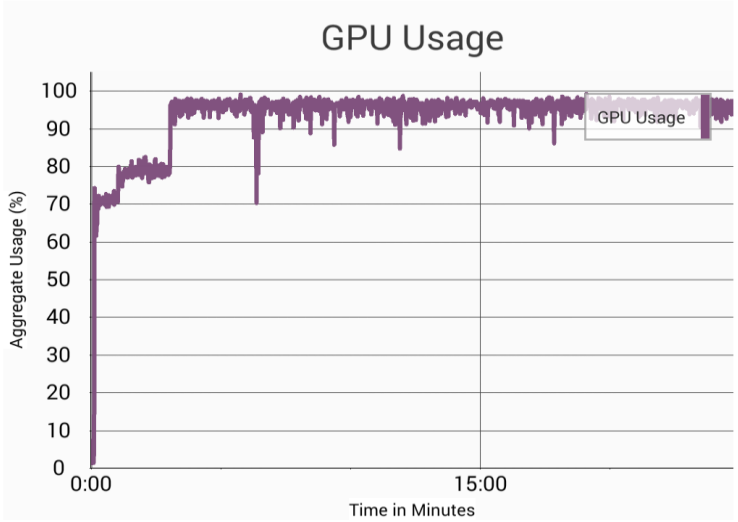
- 30 FPS (Camera API)
- CPU: 7%
- RAM: 232 MB
- GPU: 96%
- 2.4 Hours Battery







Challenges

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- Real time imagery
  - Refresh Rate
  - Time delay
- Proper stereoscopy
- Field of view
  - Fisheye Lens

Future Directions

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- Medical studies
  - Usability of diagnostic tools
  - Vision improvement
- Sensory expansion
  - UV/IR
  - Sound
  - Magnetic fields, other data sources

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Questions?

Comments?

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