

Grounded Mixed Reality: Avoiding the “Sticker Effect”

John Austin
Founder, A Stranger Gravity

Hello!

John Austin

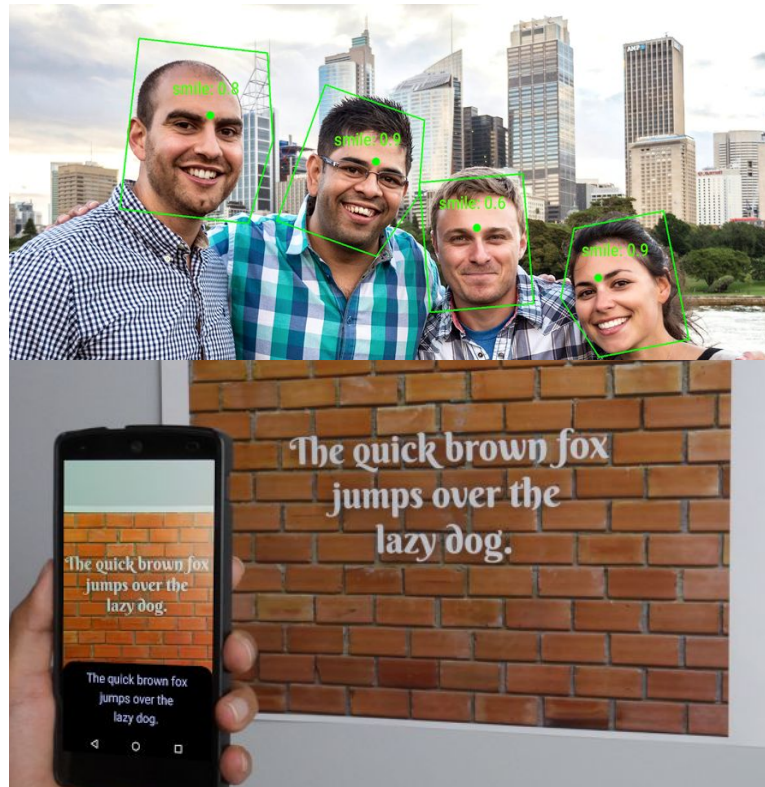
A STRANGER GRAVITY



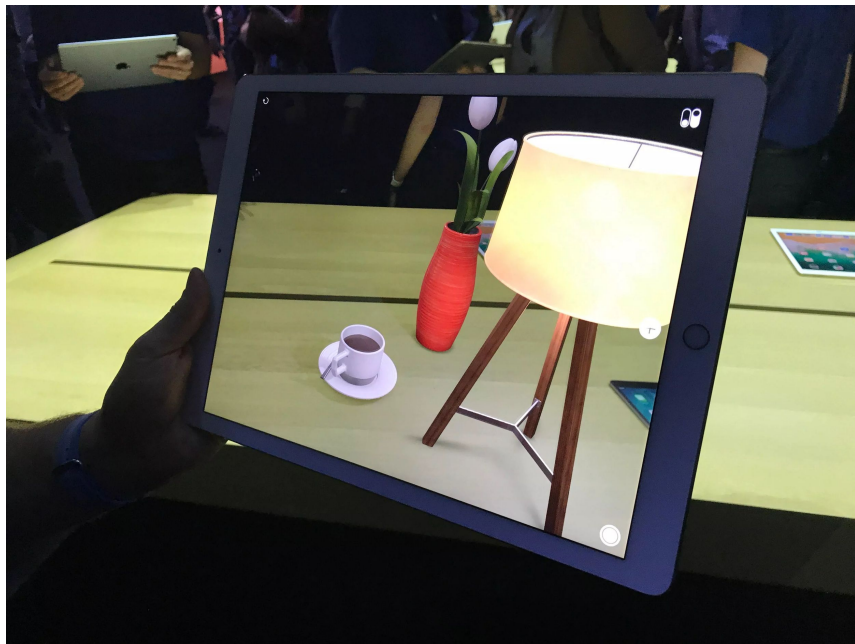
Past:



Google Research and Machine Intelligence

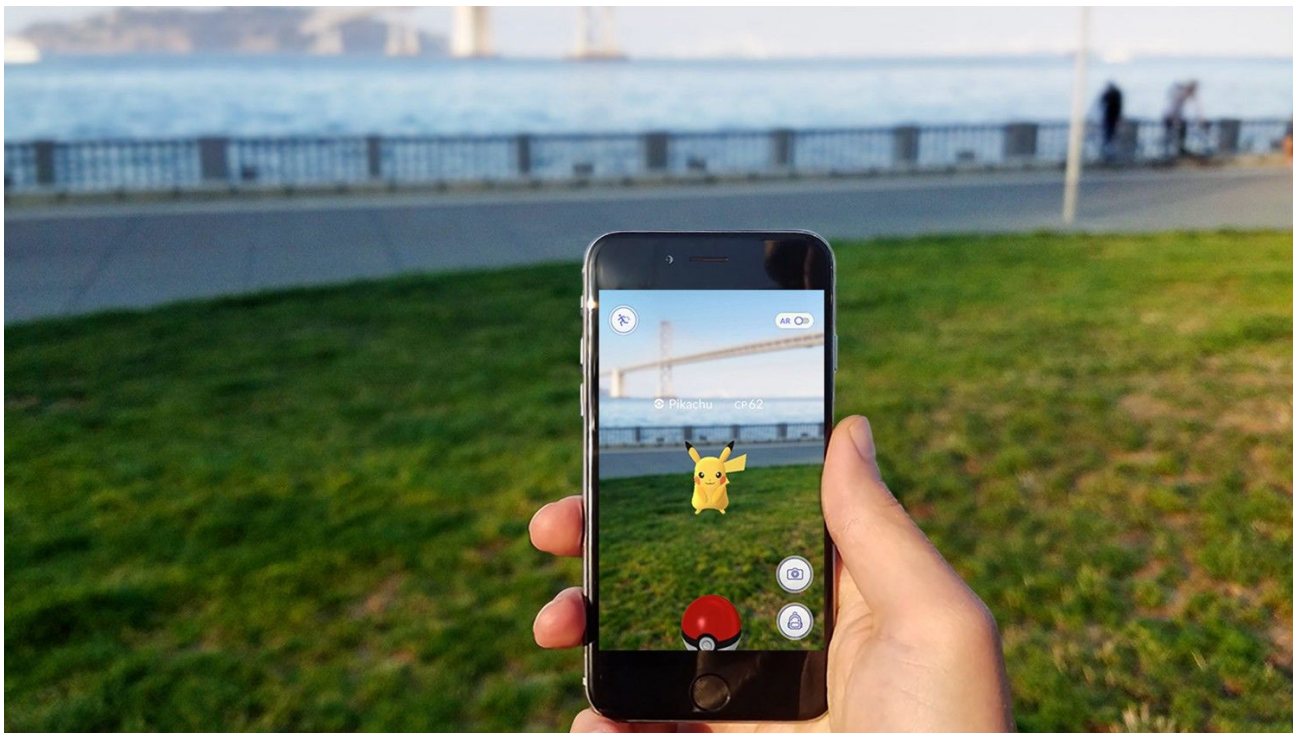


What is (visual) AR?



Overlaying objects into a real world scene.

left: Apple arkit (ios11); right: google arcore



Pokemon Go



Your shopping trip in 2025 as seen from the point of view of 1995.

hyper-reality: Keichii Matsuda

What is (visual) AR?

Overlaying virtual objects on top of the world?



Synthesizing Obama: Learning Lip Sync from Audio -- SIGGRAPH 2017 -- [Supasorn Suwajanakorn](#), [Steven M. Seitz](#), [Ira Kemelmacher-Shlizerman](#)

What is (visual) AR?

AR will be able to **synthesize** virtual things into the world and modify the world directly.

Overlays are just a part of this.

The Promise of AR

The feeling that a virtual object / character exists in your world, when viewed through a special lense.



Limitations of Current AR

Little contextual/environmental understanding.

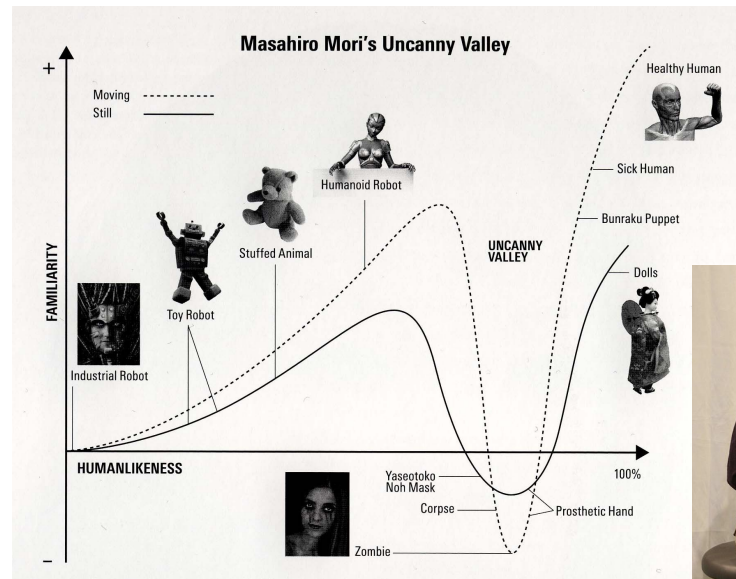
Poor ability to synthesize content into scene.



The Sticker Effect

The Uncanny Valley

Something *looks* human, but something is off.



Repliee Q2, Osaka University

The Sticker Effect

The **sticker effect** is the uncanny valley of augmented reality.

Bad AR feels like a sticker pasted onto your screen, rather than an object embedded in the world.

Combating The Sticker Effect

- Visuals
- Game Design

Visuals

- Realism
- Synthesis

Lighting Estimation

Arkit / Arcore support this natively! :) Use it!

Can go further if we treat the camera texture as a wrapper for global illumination.

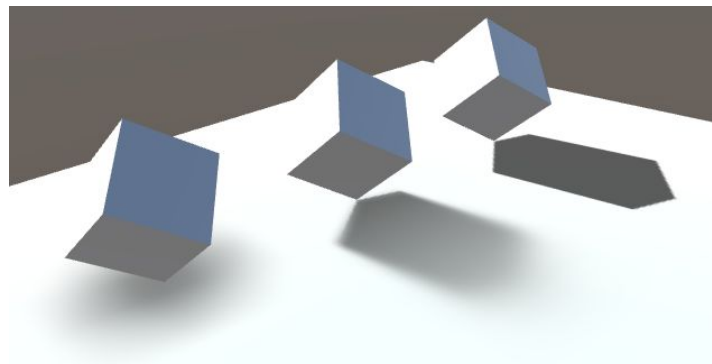
Diffuse lighting models fit more lighting environments.



Under-Shadows

Shadow textures (only effective for static models).

Aim for realtime + soft shadows.



Shadows Reflect the Sky

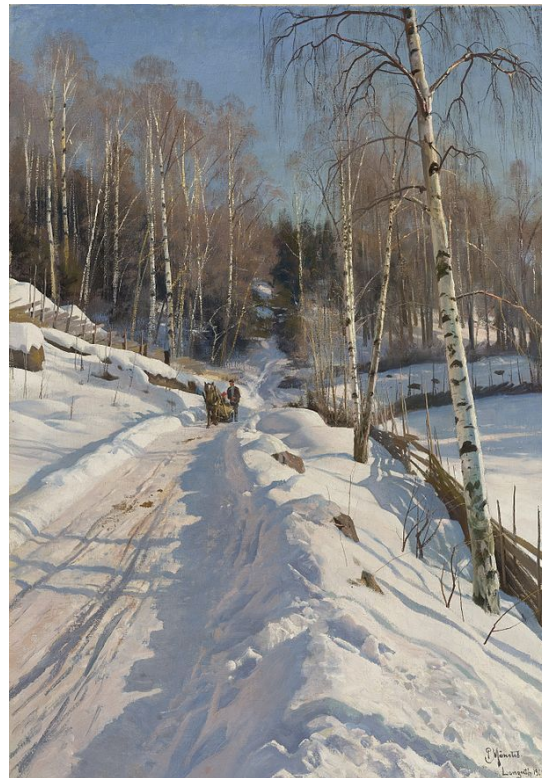
Match your shadows to your scene temperature.

Outdoor scenes have bluer shadows because they reflect the light of the sky.

Options:

- Manual shadow coloring

- Skybox reflection

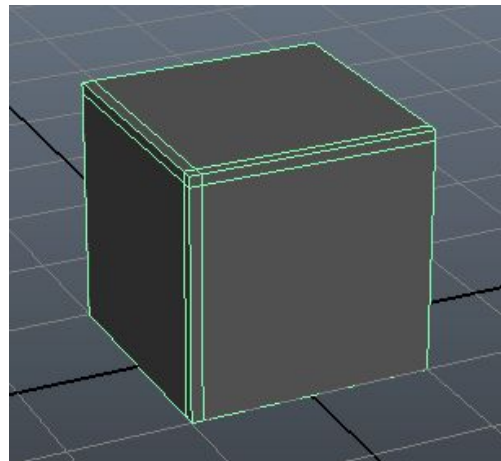


Sleigh Ride on a Sunny Winter Day by [Peder Mørk Mønsted](#)

Beveled Edges

Most objects do not have sharp edges. Almost all have slight bevels or rounded corners. Even the edge of a table is slightly rounded.

Bevels catch glints of specular light.



Beveled Edges



Beveled Edges



Contact shadows

Beveled edges cause contact shadows even on seemingly sharp-edged objects.

Ambient occlusion along the line of contact of an object with a surface.

Implementation:

- SSAO is solid, but too low frequency.

- Can author this into texture if crucial for your use case.

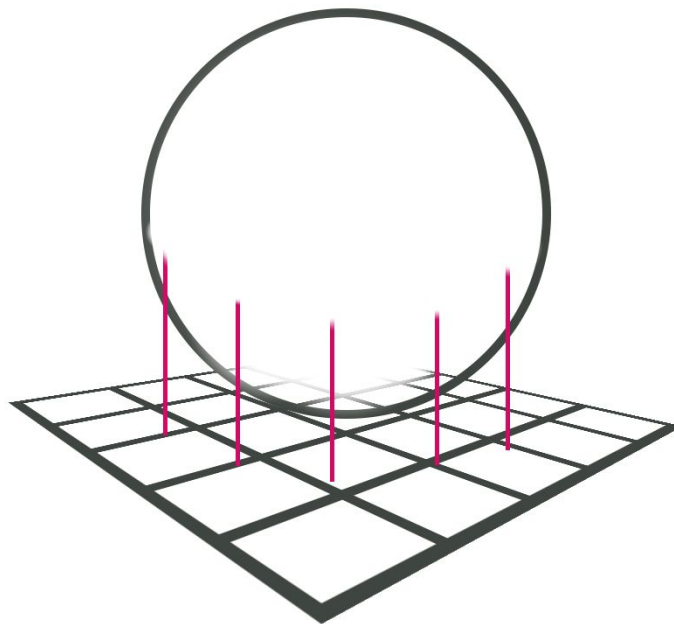


Camera Sampling

Techniques that leverage the information contained in the camera image.

Sample the camera texture at points where you can make reasonable assumptions about the depth.

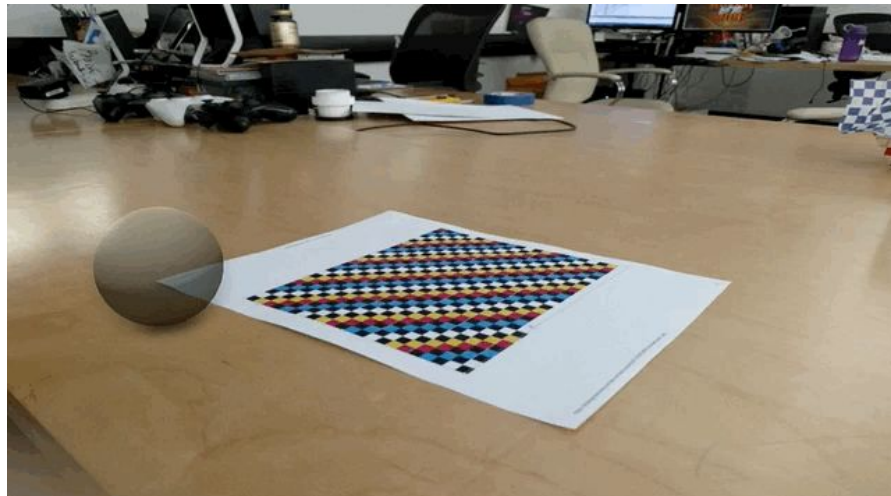
Select points in world space, project into screenspace in a shader.



Camera Sampling - Transparency

Just sample the points at the screen space positions of each fragment / vertex.

A nice approximation of transparency. Allows for control over scene blending.



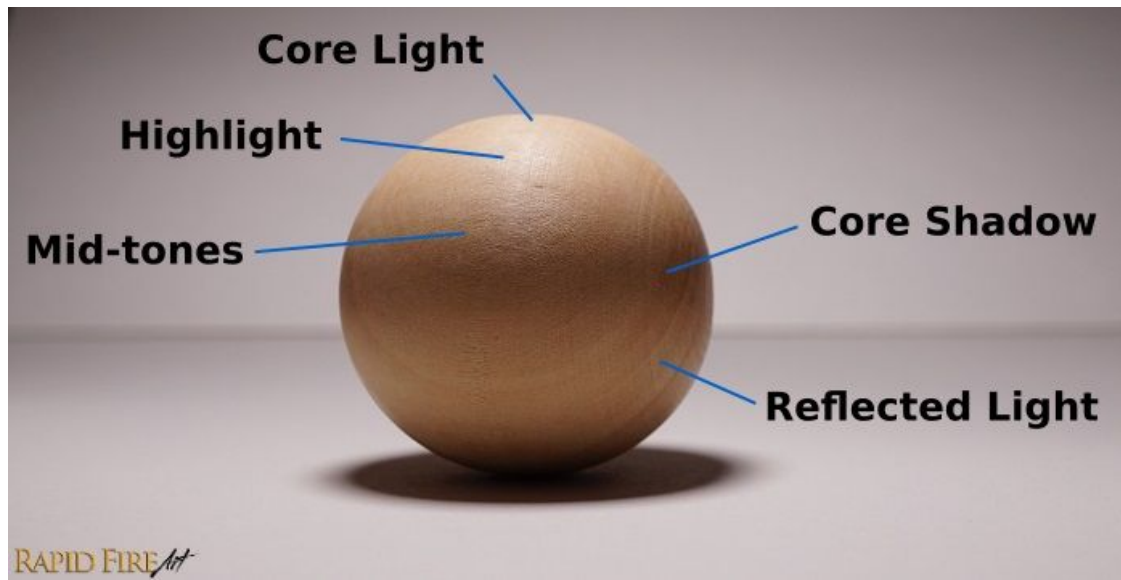
Camera Sampling



Camera Sampling - Realtime Lighting

Surfaces reflect light onto the objects near them.

Reflected light from the ground plane strongly sells the object's connection to the surface.



Camera Sampling - Indirect Lighting

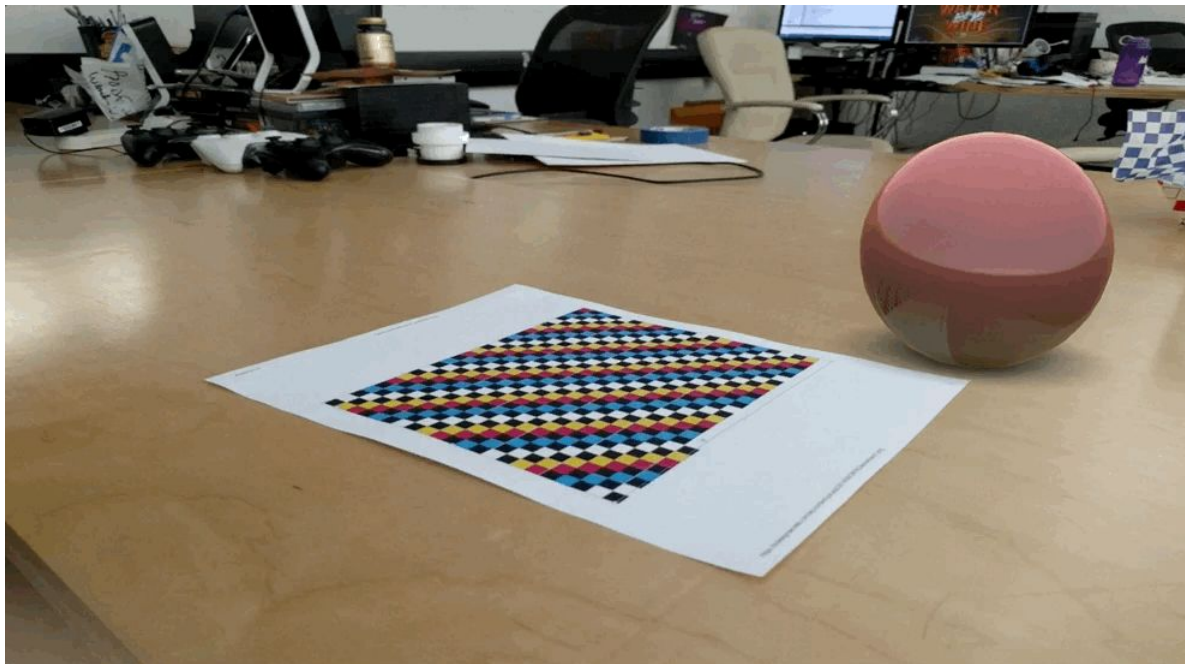
Subtle, but really helps sell ground connection.

(probably hard to see on the projector)



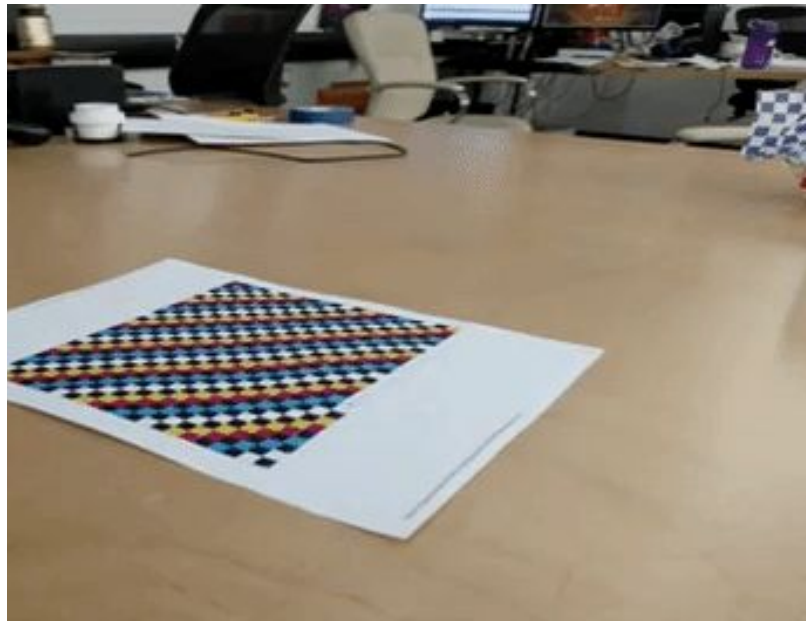
Camera Sampling - Realtime Reflections

Real-time reflections for free!



Camera Sampling - Modifying the World

1. Save vertex world space positions
2. Displace vertices
3. Render screen texture from previous position



Camera Sampling - Modifying the World



Camera Sampling - Modifying the World



Game Design

Don't make assumptions.

- Not everyone has a clean floor!
- Some houses have round walls!
- Leverage the world geometry rather than fighting to fit the world around your game.

Design things to mold to surfaces, rather than lay flat.

Favor messier, organic objects.



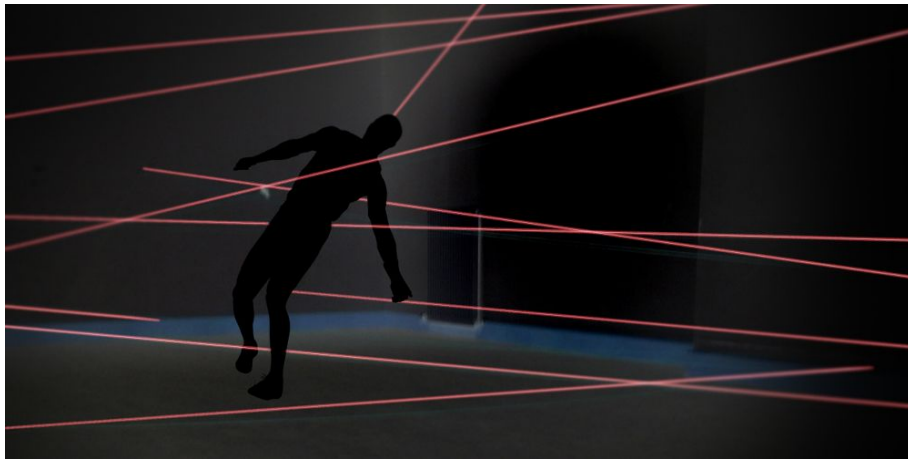
Make it Creative

The player can do the environmental understanding that we can't!

Leverage player creativity and ownership as a driving factor.

Make it Creative

Example: Lasers Game



Caveat: Bad Creativity

- “Game setup” isn’t always creative.
- Creativity should be embedded in mechanics, don’t just make players do the heavy lifting.

Managing Player Expectations

Set achievable expectations.

If you have characters, make them fallible.

It's odd for humanoids to ignore walls, but not for ghosts.

Don't choose things that **need** context.

Case Study: IKEA

Creative

Realistic rendering (real models)

Affordances/expectations of virtual objects are clear.



Closing Thoughts

The future is going to be a weird place.



View Synthesis by Appearance Flow: Tinghui Zhou, Shubham Tulsiani, Weilun Sun, Jitendra Malik, Alexei A. Efros

Closing Thoughts

The future is going to be a weird place.



Context Encoders: Feature Learning by Inpainting: Deepak Pathak, Philipp Krähenbühl, Jeff Donahue, Trevor Darrell, Alexei A. Efros

Closing Thoughts

Develop responsibly!

Context Encoders: Feature Learning by Inpainting: Deepak Pathak, Philipp Krähenbühl, Jeff Donahue, Trevor Darrell, Alexei A. Efros

Thanks!

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Flying vs. Grounded Objects

Tradeoffs:

Objects that are placed on surfaces feel far, far more “grounded”, but have the side effects that they have very limited movement. Unless you’ve properly scanned the environment, they can’t really navigate without breaking the illusion.

Flying objects are mostly free to navigate wherever in the environment, but lose the benefits of groundedness that comes from something sitting on your floor.

Tone-mapping

Match your lights and darks.

Multiple objects that interact.

Avoids objects feeling isolated / static.

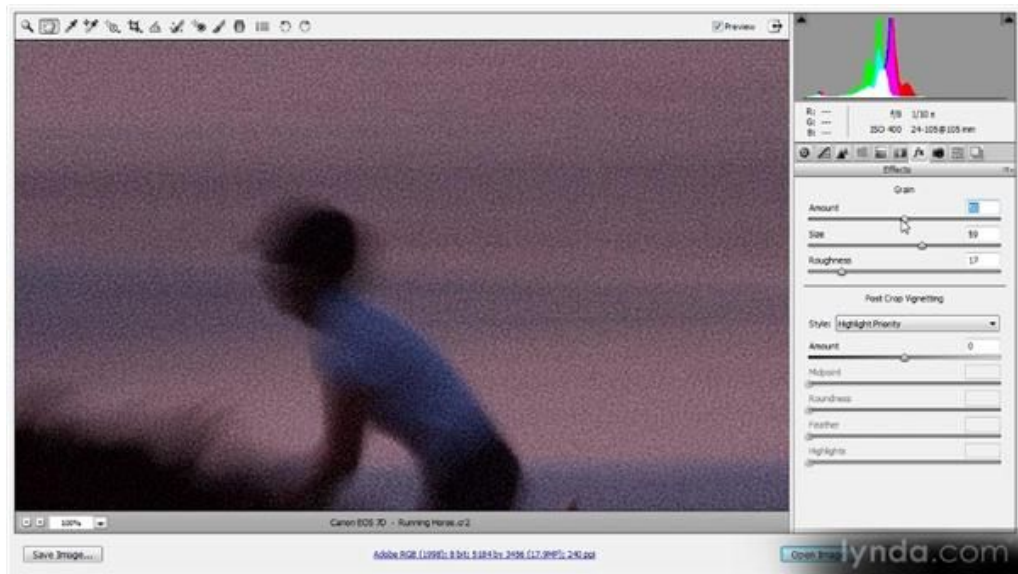
Helps sell that there is a virtual world rather than just a single virtual object.



Grain Matching

Most phone cameras have a touch of grain.

It's a subtle but nice touch.



Contact shadows



Abstraction

Dodges the uncanny valley

Abstract designs don't need
environmental context.



ARQUA (Cabbibo)

Working with Mobile AR

Pros:

- You're not doing much rendering
 - Bigger relative budget for effects work
- Only need to target high end devices that support AR.
 - Avoids iOS/Android compatibility hell.

Cons:

- You're competing with the AR routines themselves for processing.
 - These routines tend to run on the CPU.
- Ergonomics