




3-D Facial Imaging for Identification

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The Team

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The Vision

- For program like Global Entry, NEXUS, or SENTRI
 - Capture 3D as trusted travelers are walking down hall
 - Perhaps driver of car entering USA?
- Use 3D face shape for identification
 - Ex.: comparison with a card or passport with RFID
 - *3D face shape found as effective as high-resolution photography or iris recognition in 2006 Face Recognition Vendor Test Report*



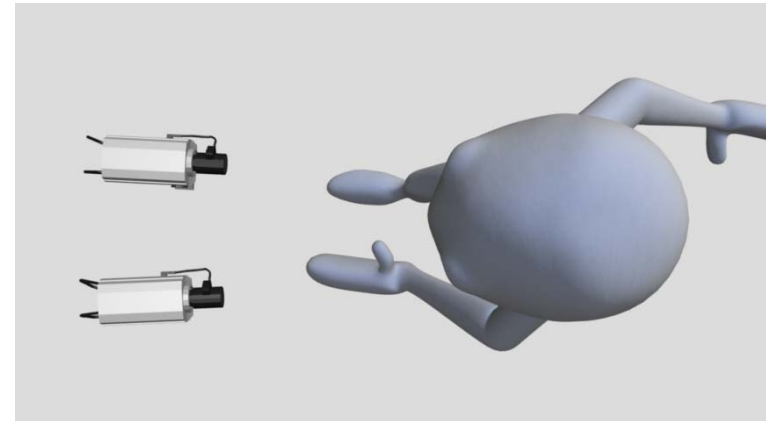
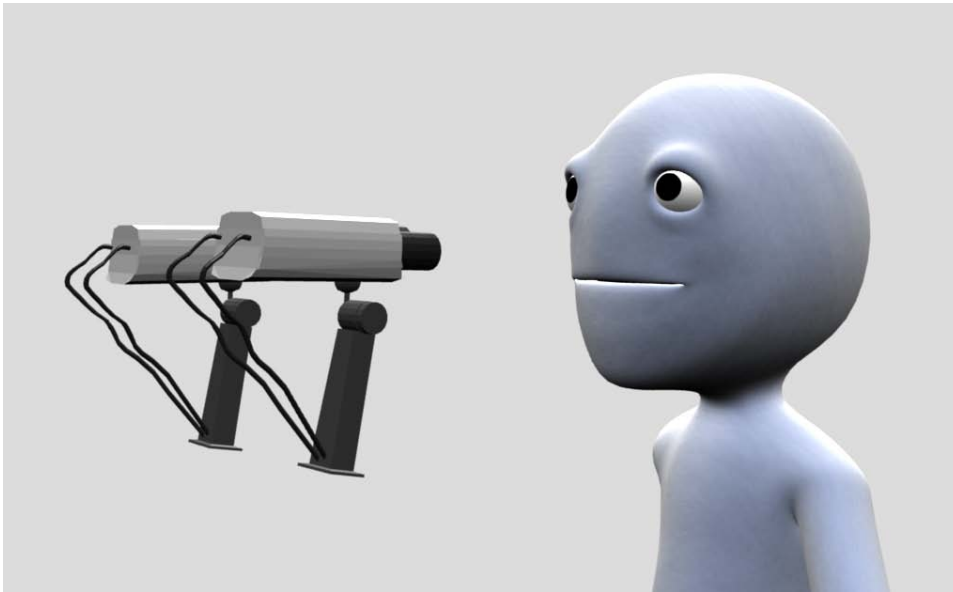
The Project

- Goals are to capture a 3D model of the face
 - Accurately,
 - Rapidly, and
 - Unobtrusively
- **How do you do this?**



Basics of Stereo Vision

- Use 2 (or more) cameras

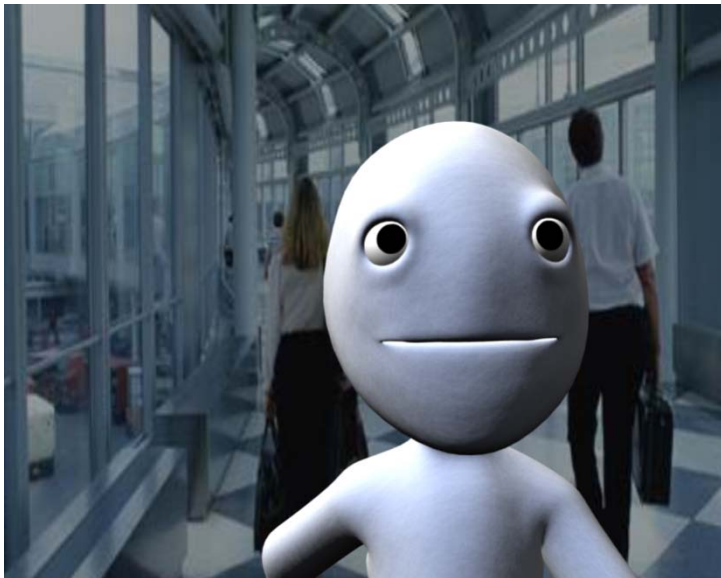


Top View



The Two Camera Views

- Notice that they're different, like from your 2 eyes



Left Camera

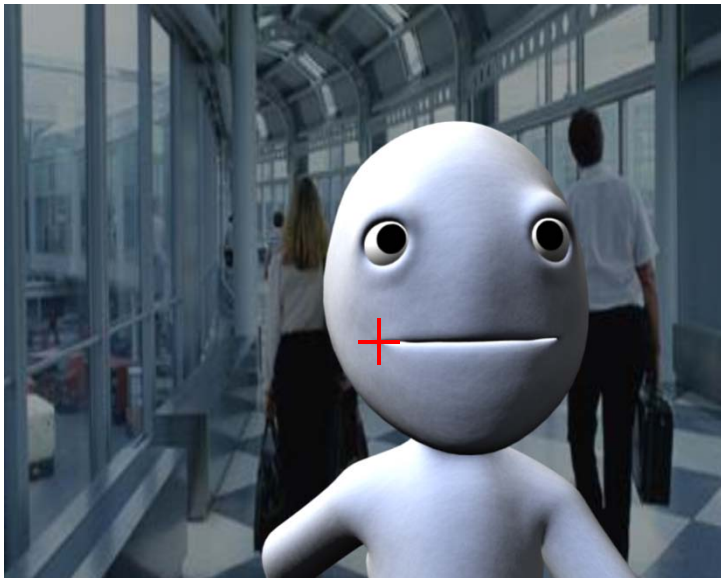


Right Camera



Making the 3D Model

- If we can identify same point in 2 views, we can compute depth at that point, and thus 3D model



Left Camera

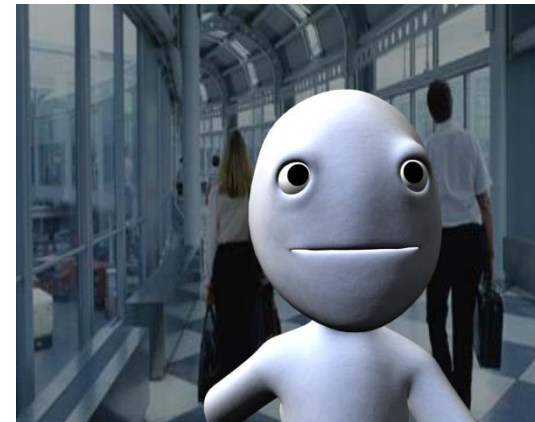


Right Camera



Big Problem: Correspondence

- What if we can't find corresponding point?
 - Like our poor friend's nose?
 - Or a human's cheeks or forehead?
- This is a general problem
 - Imagine making 3D model of object with a solid color



Structured Light

- The idea is to project texture on the object (in this case, the face)
- Flashing textures, however
 - are disturbing, and
 - not good idea while walking

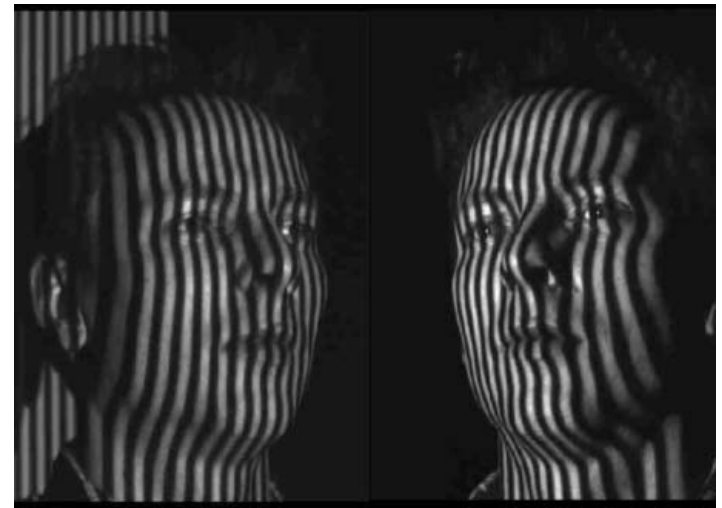


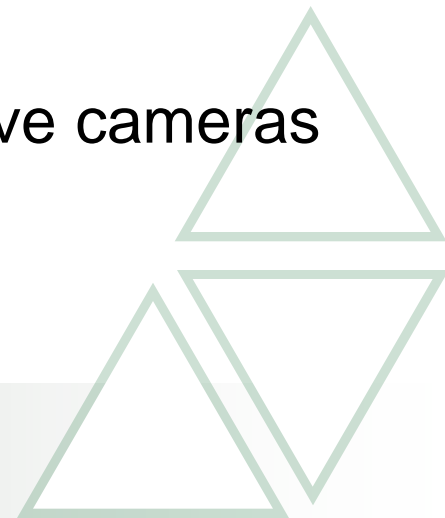
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- Which leads us to one task of this project



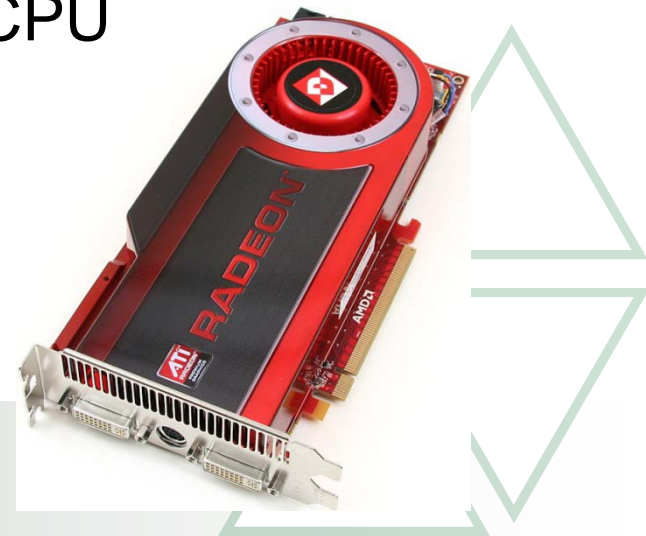
Imperceptible Structured Light

- Use light imperceptible to human, while visible to camera
- Two approaches
 1. **Imperceptible Structured Light** – rapidly flash pattern and then inverse of pattern (human can't perceive if above flicker frequency – looks like white light)
 2. **Infrared** light source and infrared sensitive cameras



Speed

- Computation another big problem
 - Acquire images in fraction of second
 - Don't want to wait 10 seconds to process
- Second major task: speed this up
- Our solution: use graphics processor (GPU)
 - Can be up to 40 times faster than CPU
 - Highly parallel



Remaining Project Work

- Today we're presenting preliminary results
 - Still need more work to complete both parts
- Next
 - Infrared
 - Have ordered parts to build
 - Will compare to visible light
 - Low Light (optional)
 - Would like to not have to blast the people with light (whether visible or IR)
 - Also for good results on darker skin
 - Will investigate techniques for low contrast



More Challenges

- To achieve our full vision, need to
 - Cover large spaces
 - Multiple projectors
 - Overlapping cameras
 - Handle moving people
 - Fill in detail over time

