Bridging the Paper and Electronic Worlds

Johnson, Jellinek, Klotz, Card.

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What its about

- Paper exists
- Its useful and persistent
- Xerox is concerned with doc management
- Scanning is problematic (more so in ‘93)

Paper UI

- Put digital markers (”glyphs”) on paper that are resistant to low-resolution and noisy digitization
- Put form boxes on paper
- Fax them to application server
- Do OCR and send info to database

Results

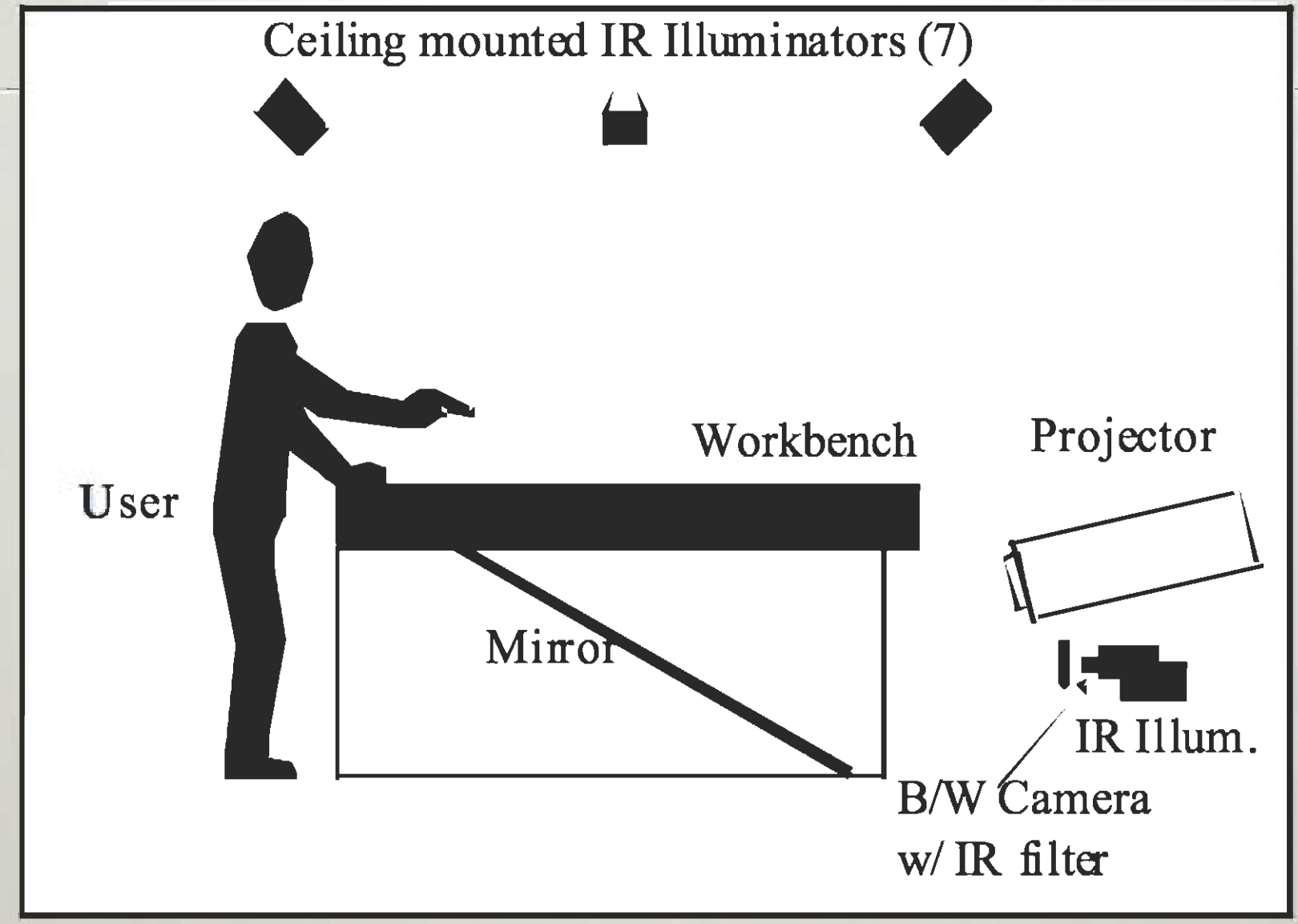
- People found it more intuitive to use
- Currently Onoto pens would be better suited to avoid OCR and faxing process
- Better yet use e-paper or projected AR

The Perspective Workbench: Towards Spontaneous and Natural Interaction in Semi-Immersive Virtual Environments

Leibe, Starner, Ribarsky, Wartell, Krum, Singletary, Hodges

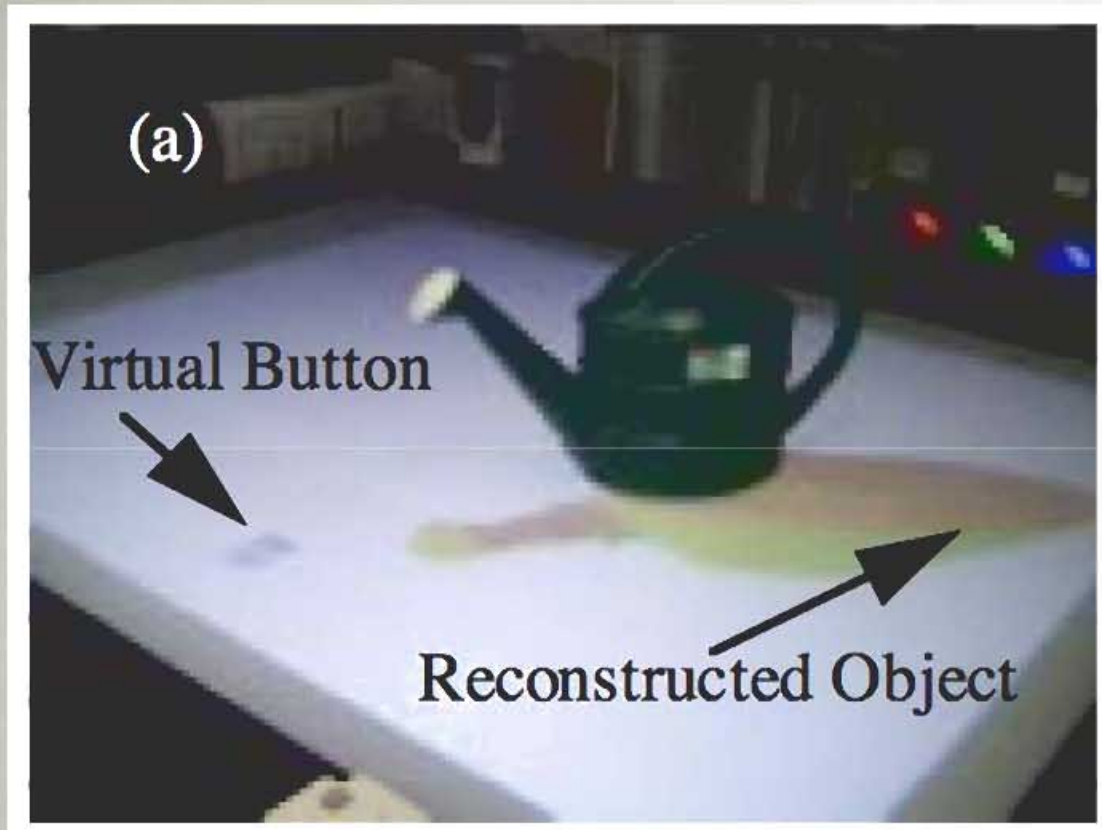
What its about

- Static setup with projected structures on desk
- Cameras capture physical objects and hands
- Limited recognition of gestures
- Untethered interface

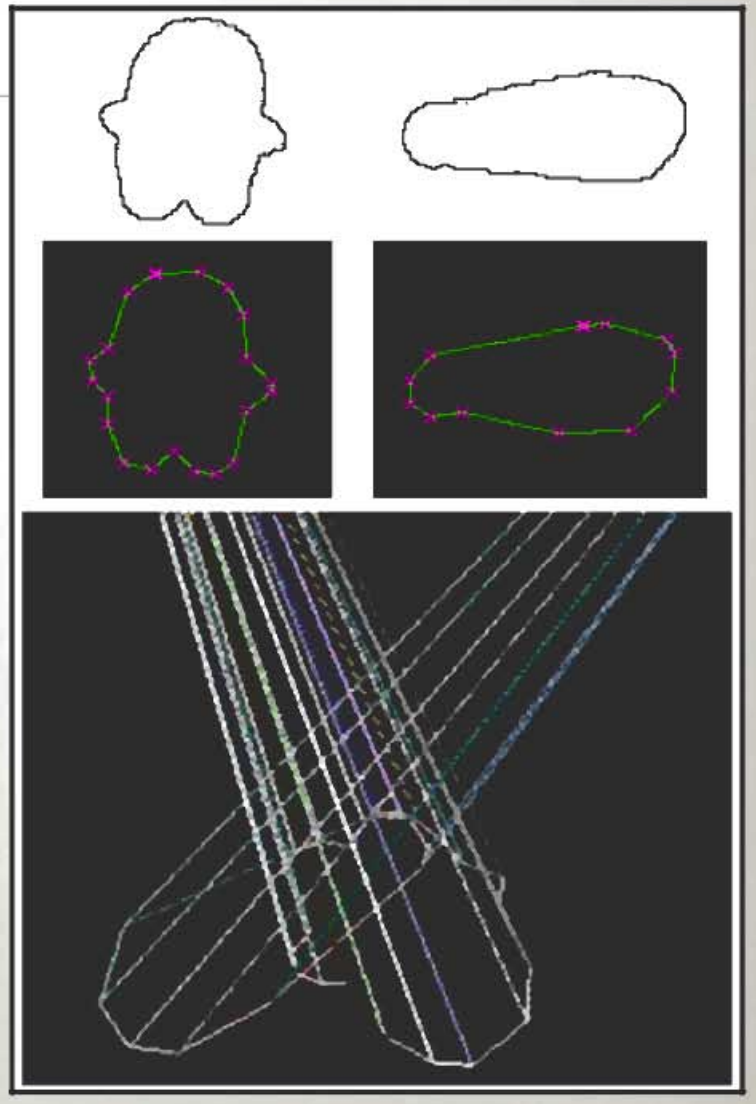

Ceiling mounted IR Illuminators (7)
User
Workbench
Projector
Mirror
IR Illum.
B/W Camera
w/ IR filter

Object Method

- Projection of IR shadows get recognized via cameras below
- Switching between 7 cameras in ring provides enough complimentary angles


(a)
Virtual Button
Reconstructed Object


(b)



Benefits

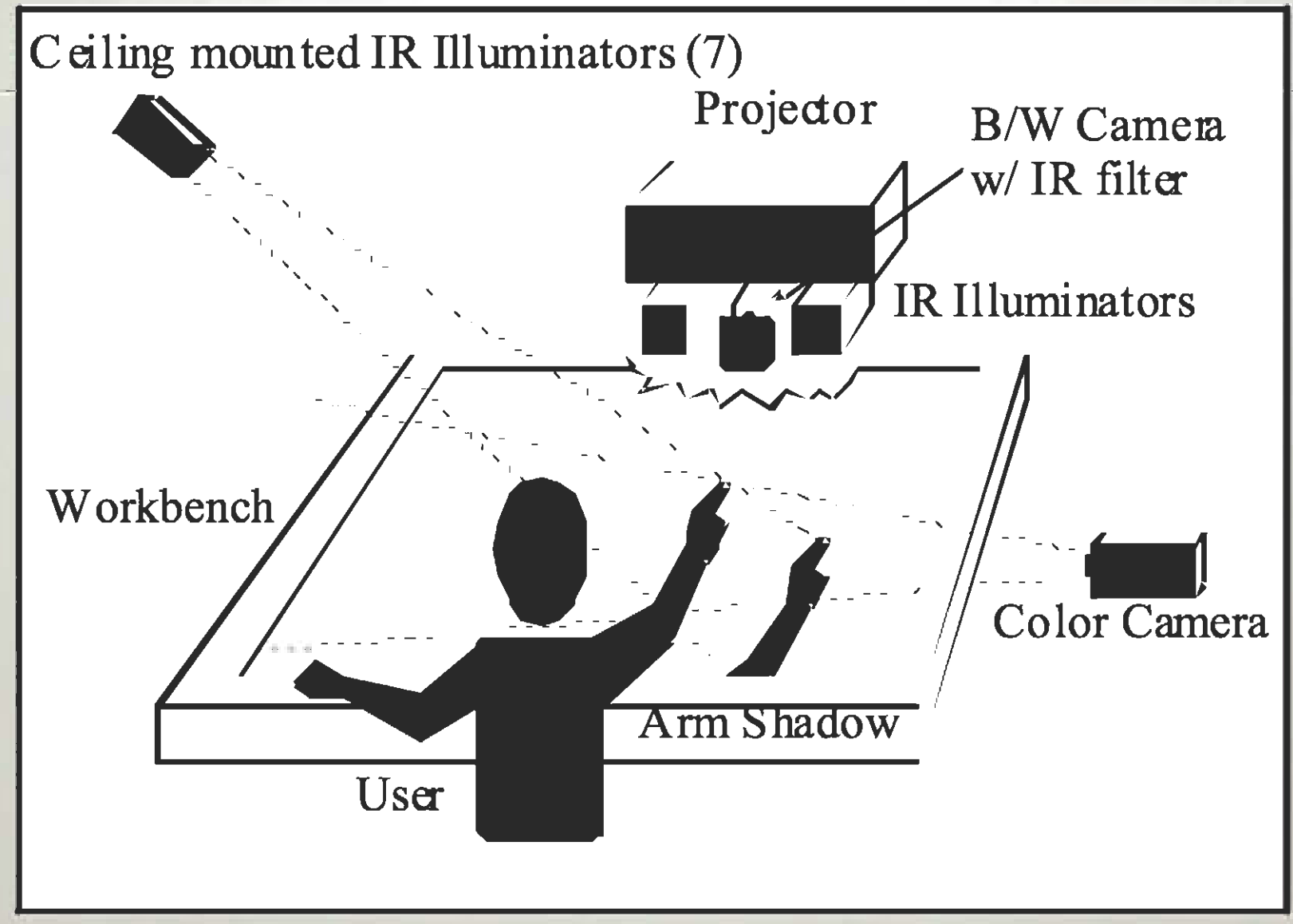
- Very inexpensive comparatively (versus stereo cameras, laser range finders, structured lighting, etc)
- Little calibration. Need to know approximate position of light sources and adjust side camera to see whole surface
- Does not use any moving parts, 7 light sources provide enough information

Gesture recognition

- Types
  - Symbolic
    - Iconic (represent an object and attribute or motion.. i.e. tilt like this)
    - Metaphoric (iconic + metaphor)
    - Beat (movement up and down)
  - Deictic (pointing)

Gesture recognition

- Needs orientation of finger and hand via recovery of 3D info
- Extending arm creates shadow, edge tells you “shoulder” = source, farthest point = fingertip
- Cast shadow + light source position = plane
- Side view camera detects arm & fingertip, extrapolates two lines in 3D
- Intersection with the shadow = two 3D points, arm + fingertip


Ceiling mounted IR Illuminators (7)
Projector
B/W Camera
w/ IR filter
IR Illuminators
Workbench
Color Camera
Arm Shadow
User

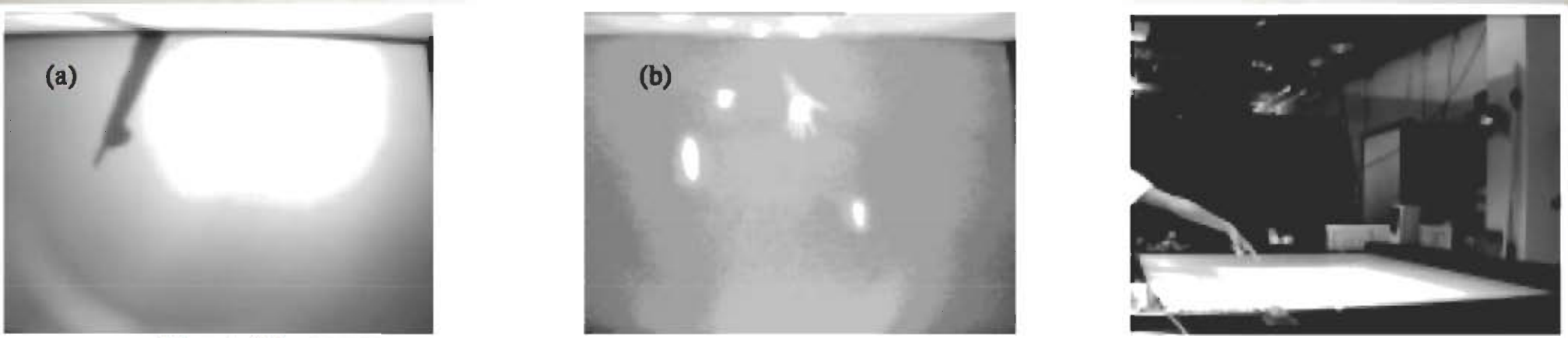


Figure 2 Images seen by the infrared and color cameras: (a) arm shadow from overhead IR lights; (b) reflections from IR lights underneath the desk; (c) image from side camera.

Results

- Achieved 12-18 FPS for objects + gesture
- Latency is 0.25 - 0.33 seconds
- Apparently works decently well
- Users with feedback adjust for lag

Object error

	Cone	Pyramid
Maximal Error	7.26%	6.9%
Mean Error	1.87%	1.3%
Mean Square Error	2.61%	1.95%

Augmented-reality visualization guided by cognition: Perceptual heuristics for combining visible and obscured information

Furmanski, Azuma, Daily

Selected Issues

- Main problem: depth ambiguity
- Augmented information must be differentiated from linking to visible and occluded objects
- Occlusion is a major problem to solve
- Motion parallax violation is bad

Selected Issues

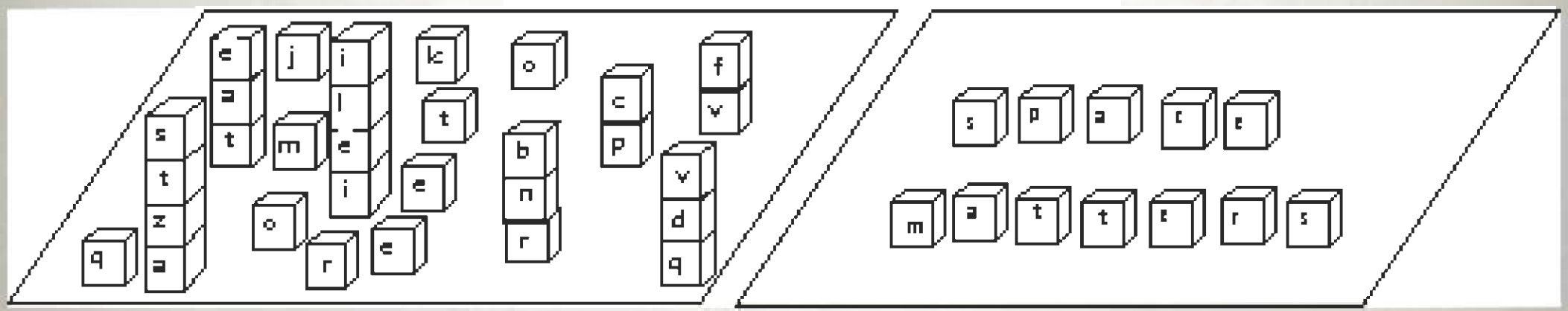
- Structure from motion might help with reducing visual complexity
- Reduce motion as much as possible

Experiment Results

- Occlusion is the dominate visual cue for depth perception (over motion parallax)
- People cannot suspend their internal knowledge of objects and occlusion given other knowledge such as motion parallax

The Intelligence Use of Space

David Kirsh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Spatial arrangements...

- ... that simplify choice
- ... that simplify perception
- ... that simplify internal computation

Reducing complexity

- Reduce fan-out of actions represented as available at decision points
- Eliminate certain decision points
- Expose unnoticed constraints
- Improve search knowledge through chunking, caching, etc...
- Speed up creation of problem space representation
- Speed up low level computation of search and heuristic evaluation

Reducing perceived actions

- Hiding affordances -- *constraining* what is seen to be feasible
- Highlighting affordances -- *cueing* attention to what is feasible

Example

- Grocery baggers
  - Need to categorize items on size, weight, fragility
  - Use spatial buffers to aid in planning when items are not immediately available
  - Nearby items are more likely to be used than distant

Offloading Example

- Tetris
  - Mental rotation takes 1000-1800ms
  - Physical rotation takes 200ms
  - Shifting the computation task to spatial matching solves the problem faster

Application

- Personalized projections of epistemic structures
- Context-sensitive ordering structures
- Coordinating structures
- Scaffolds help with task such as checklist, helpers (noted by theory of learning)
- Intelligent use of space can save computation