Microsoft

Image Understanding and Computer Vision Research at MSR Redmond and Cambridge

Microsoft Research
Faculty Summit
2015
July 8-9, 2015

Microsoft

Image Understanding and Computer Vision Research at MSR Redmond and Cambridge

Microsoft Research
Faculty Summit
2015

Zhengyou Zhang
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Microsoft Research, Redmond, WA

Computer Vision has made tremendous progress!

VB | NEWS

Channels Newsletters Jobs Got news? Tell us!

Microsoft researchers say their newest deep learning system beats humans — and Google

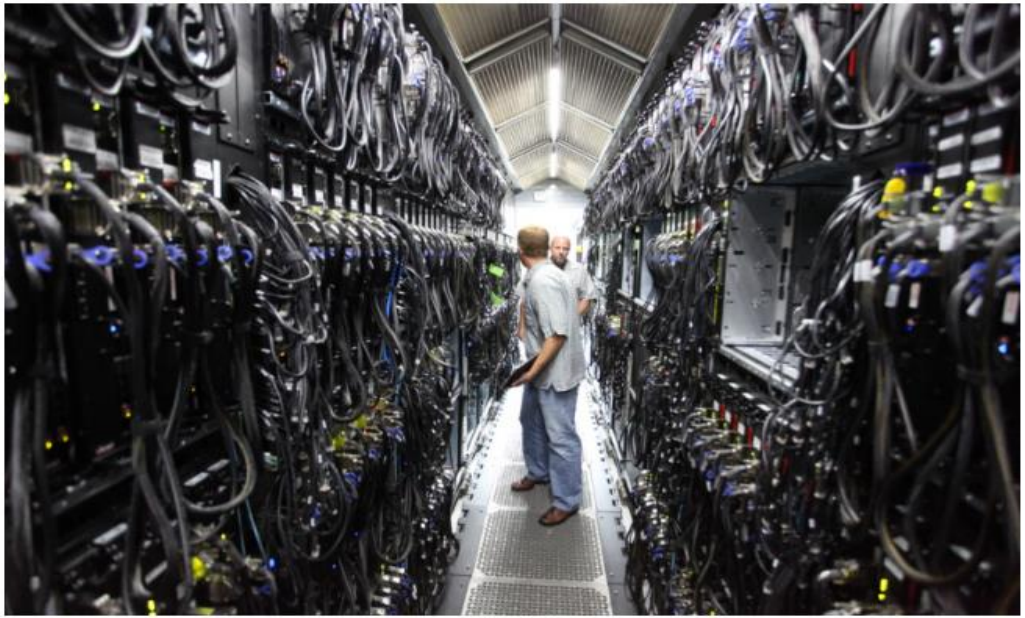
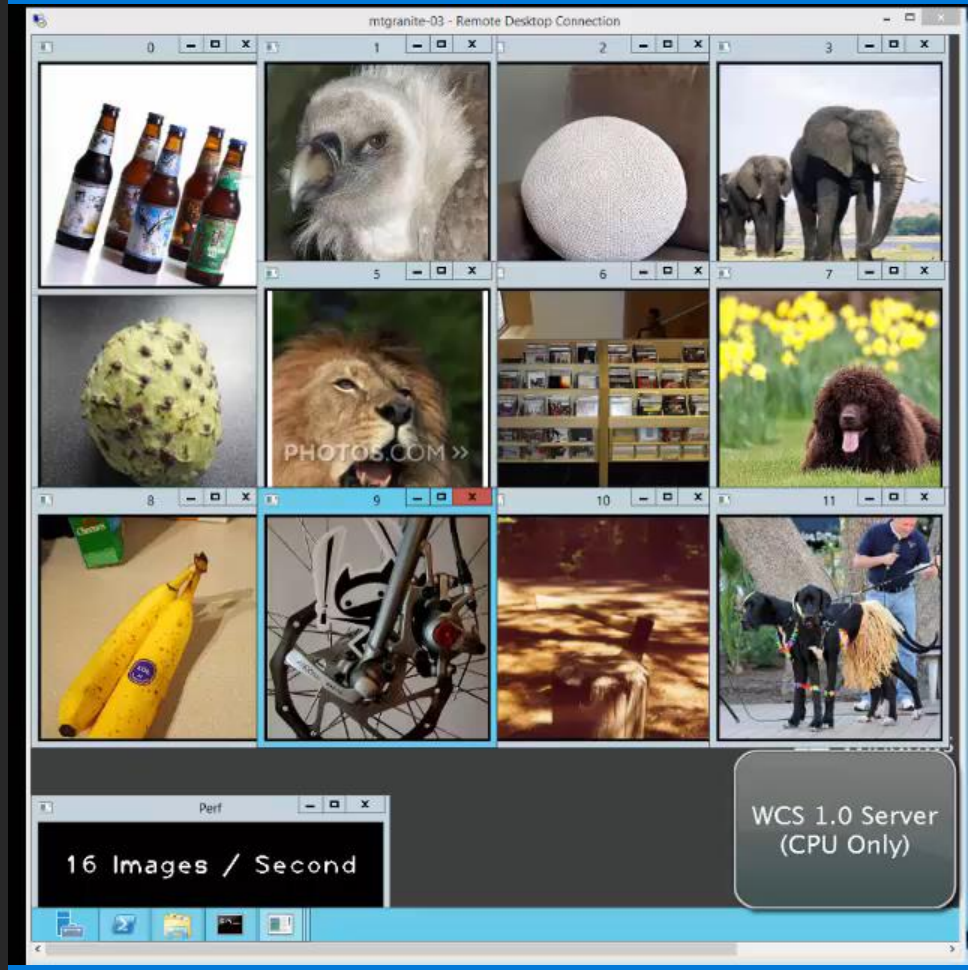


Image Credit: Robert Scoble/Flickr

Jian Sun's team at MSRA

Convolutional Neural Network Demo



Obvious mistakes made by computer

GT: letter opener
1: drumstick
2: candle
3: wooden spoon
4: spatula
5: ladle

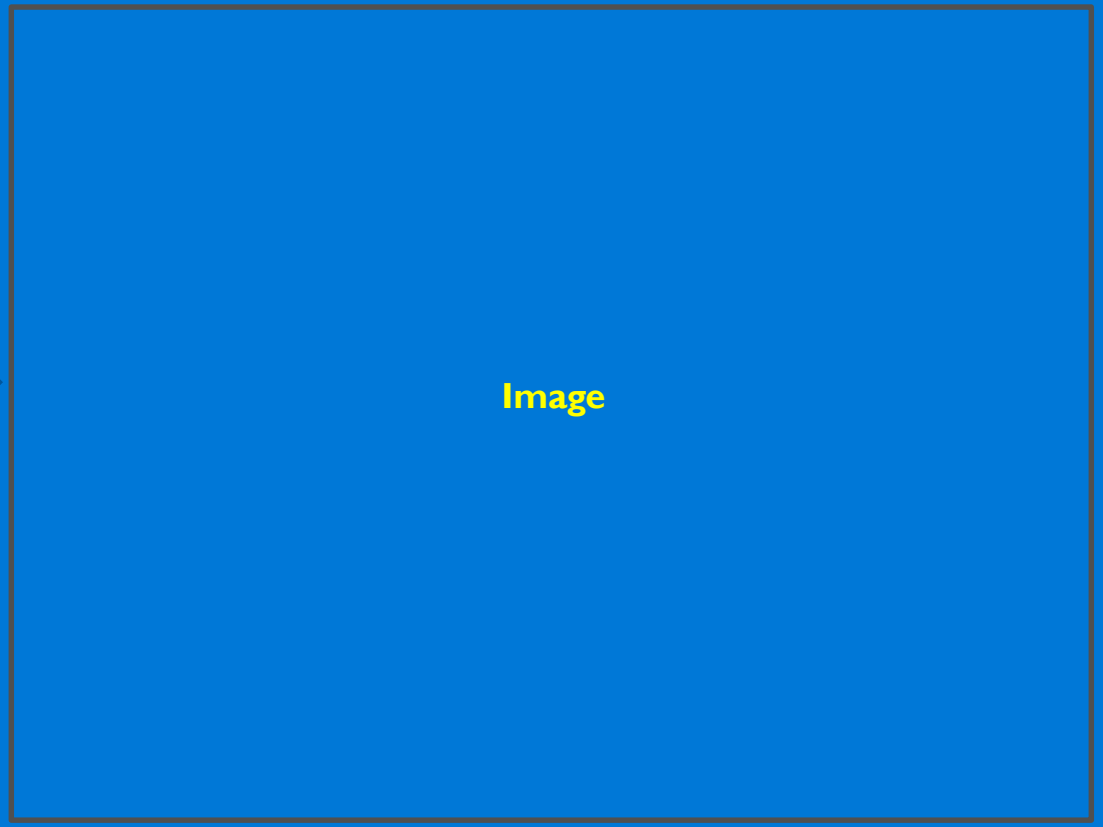
GT: letter opener
1: Band Aid
2: ruler
3: rubber eraser
4: pencil box
5: wallet

GT: letter opener
1: fountain pen
2: ballpoint
3: hammer
4: can opener
5: ruler

Computer Vision
still falls far short of what
Human Vision can do

Image Ingredients

Very many sources of variability

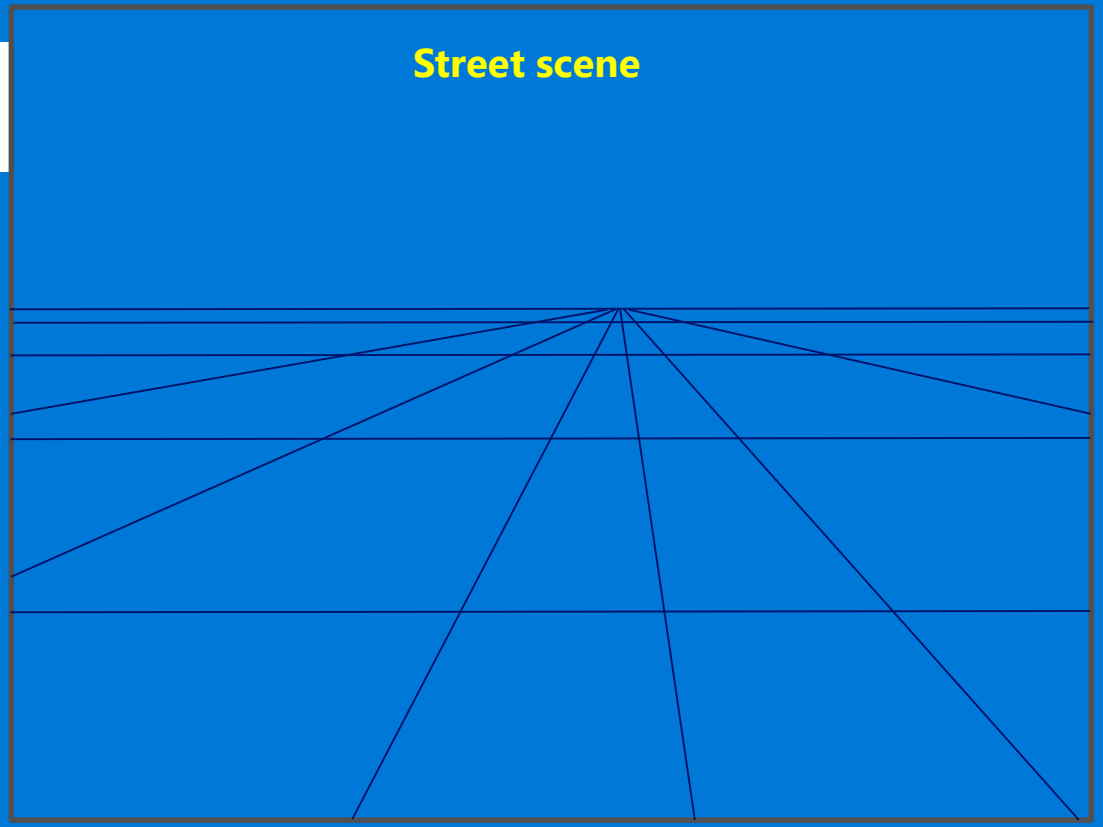


[Slide credit : John Winn]

Sources of image variability

Scene type

Scene geometry



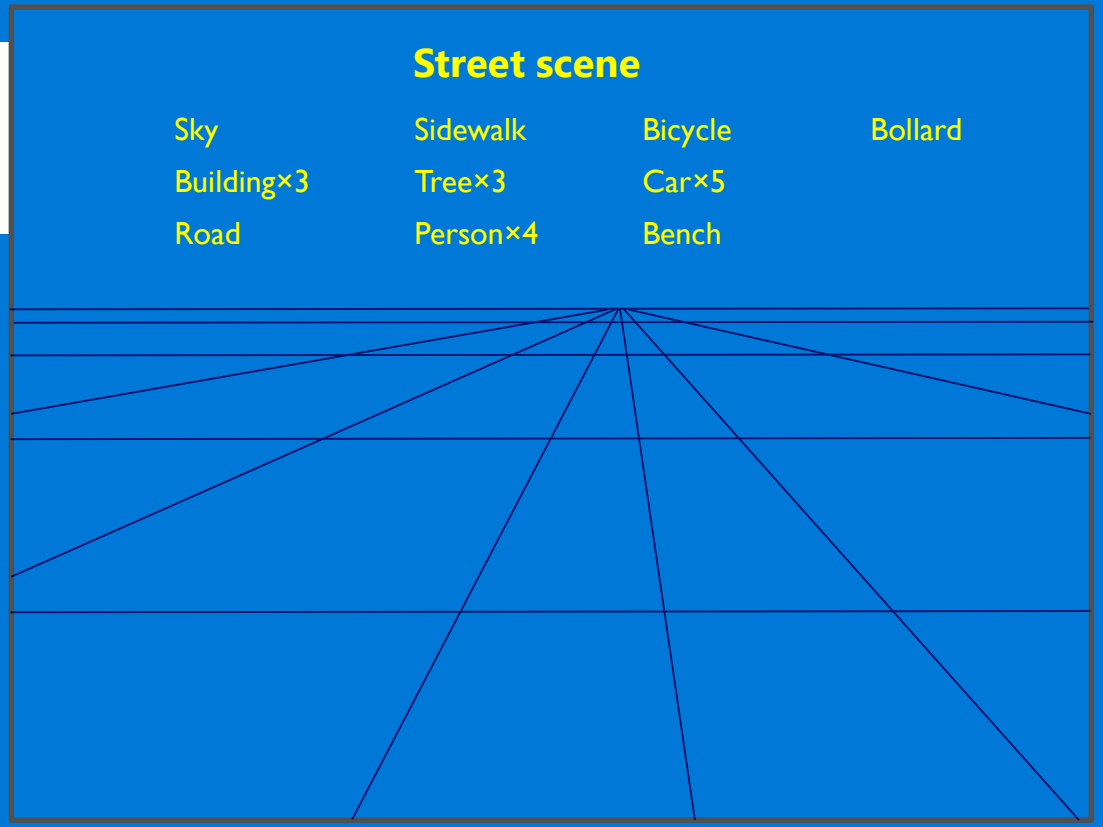
[Slide credit : John Winn]

Sources of image variability

Scene type

Scene geometry

Object classes



[Slide credit : John Winn]

Sources of image variability

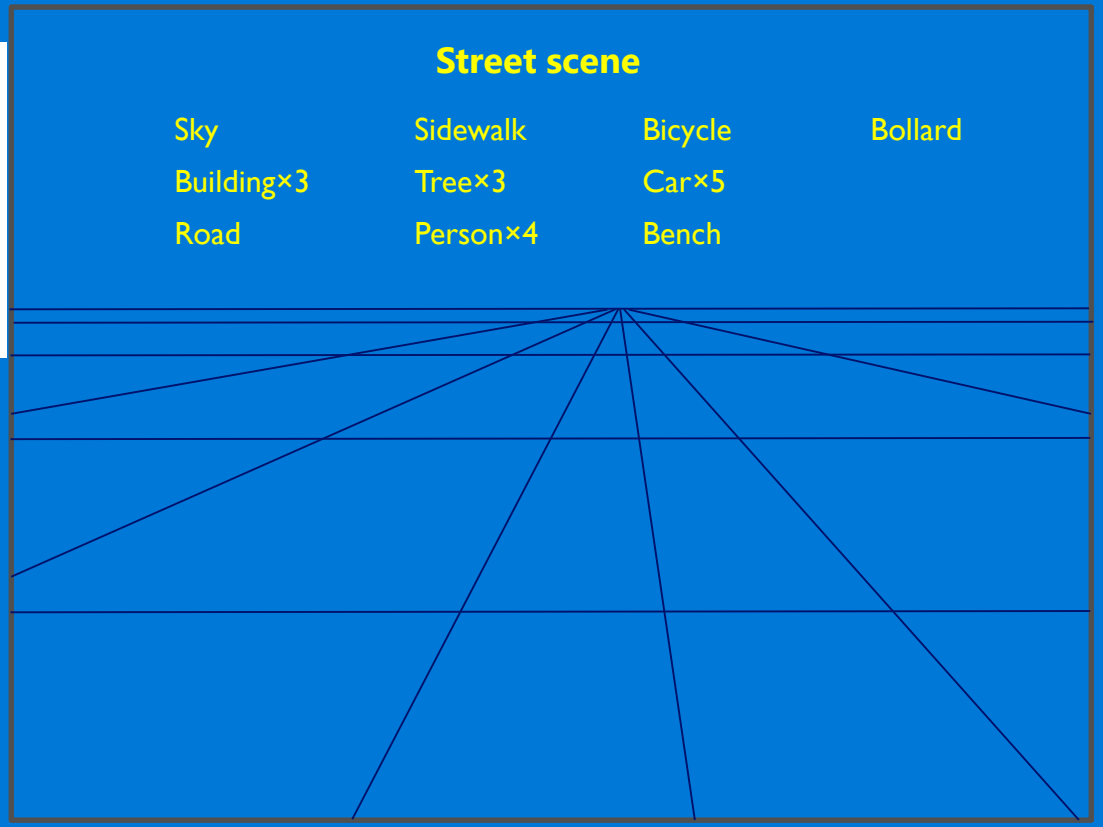
Scene type

Scene geometry

Object classes

Object position

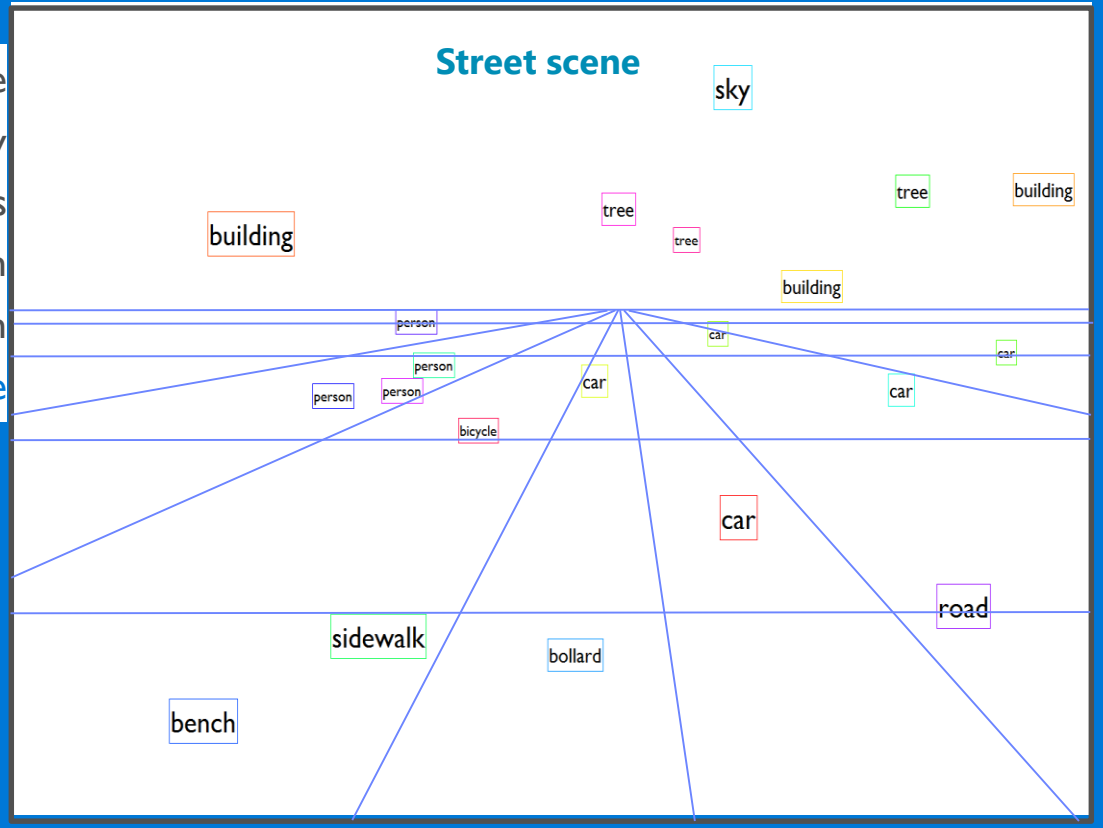
Object orientation



[Slide credit : John Winn]

Sources of image variability

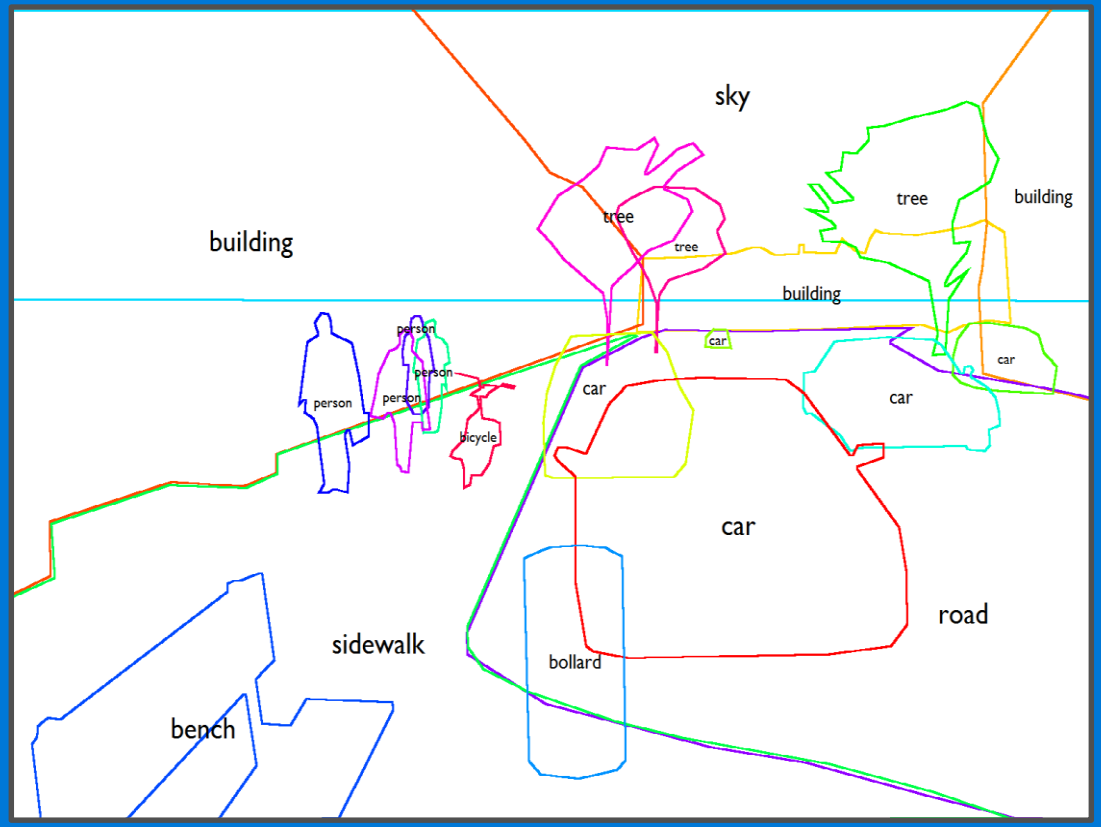
- Scene type
- Scene geometry
- Object classes
- Object position
- Object orientation
- **Object shape**



[Slide credit : John Winn]

Sources of image variability

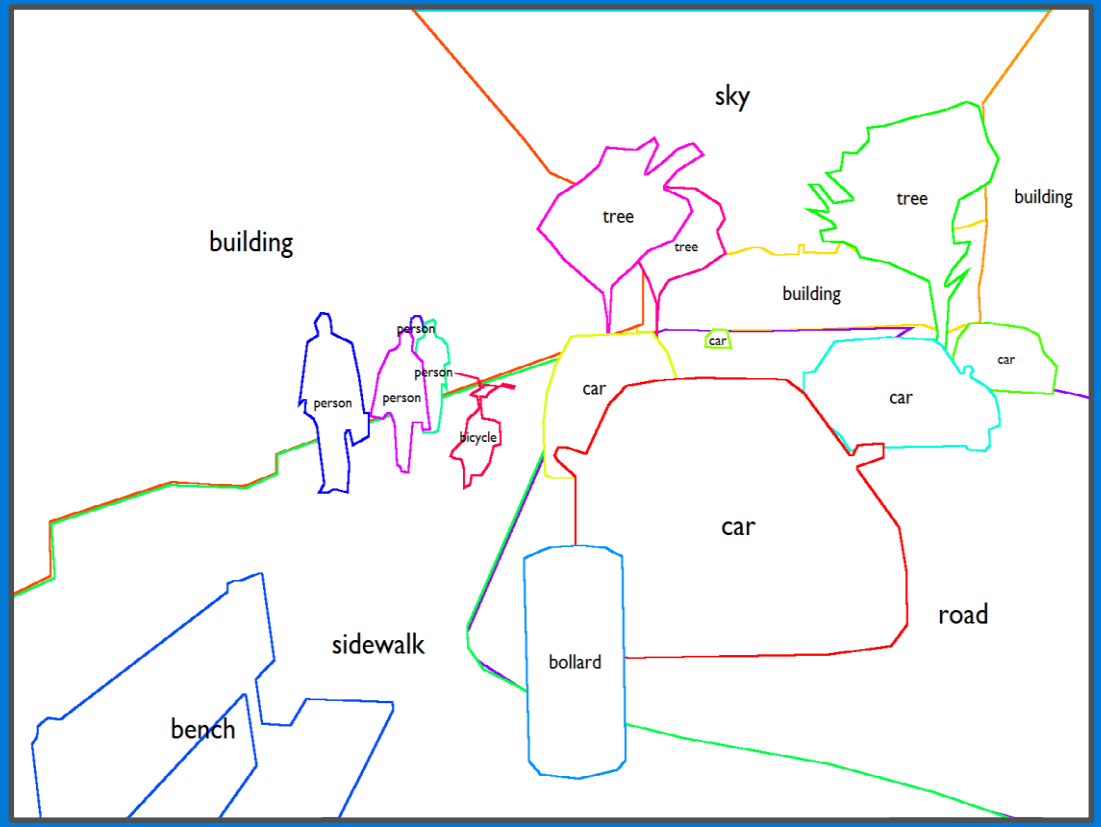
Scene type
Scene geometry
Object classes
Object position
Object orientation
Object shape
Depth/occlusions



[Slide credit : John Winn]

Sources of image variability

- Scene type
- Scene geometry
- Object classes
- Object position
- Object orientation
- Object shape
- Depth/occlusions
- Object appearance



[Slide credit : John Winn]

Sources of image variability

Scene type

Scene geometry

Object classes

Object position

Object orientation

Object shape

Depth/occlusions

Object appearance

Illumination

Shadows

[Slide credit : John Winn]

Sources of image variability

Scene type

Scene geometry

Object classes

Object position

Object orientation

Object shape

Depth/occlusions

Object appearance

Illumination

Shadows

[Slide credit : John Winn]

Sources of image variability

- Scene type
- Scene geometry
- Object classes
- Object position
- Object orientation
- Object shape
- Depth/occlusions
- Object appearance
- Illumination
- Shadows
- Motion blur
- Camera effects

[Slide credit : John Winn]

Now.. The Good News

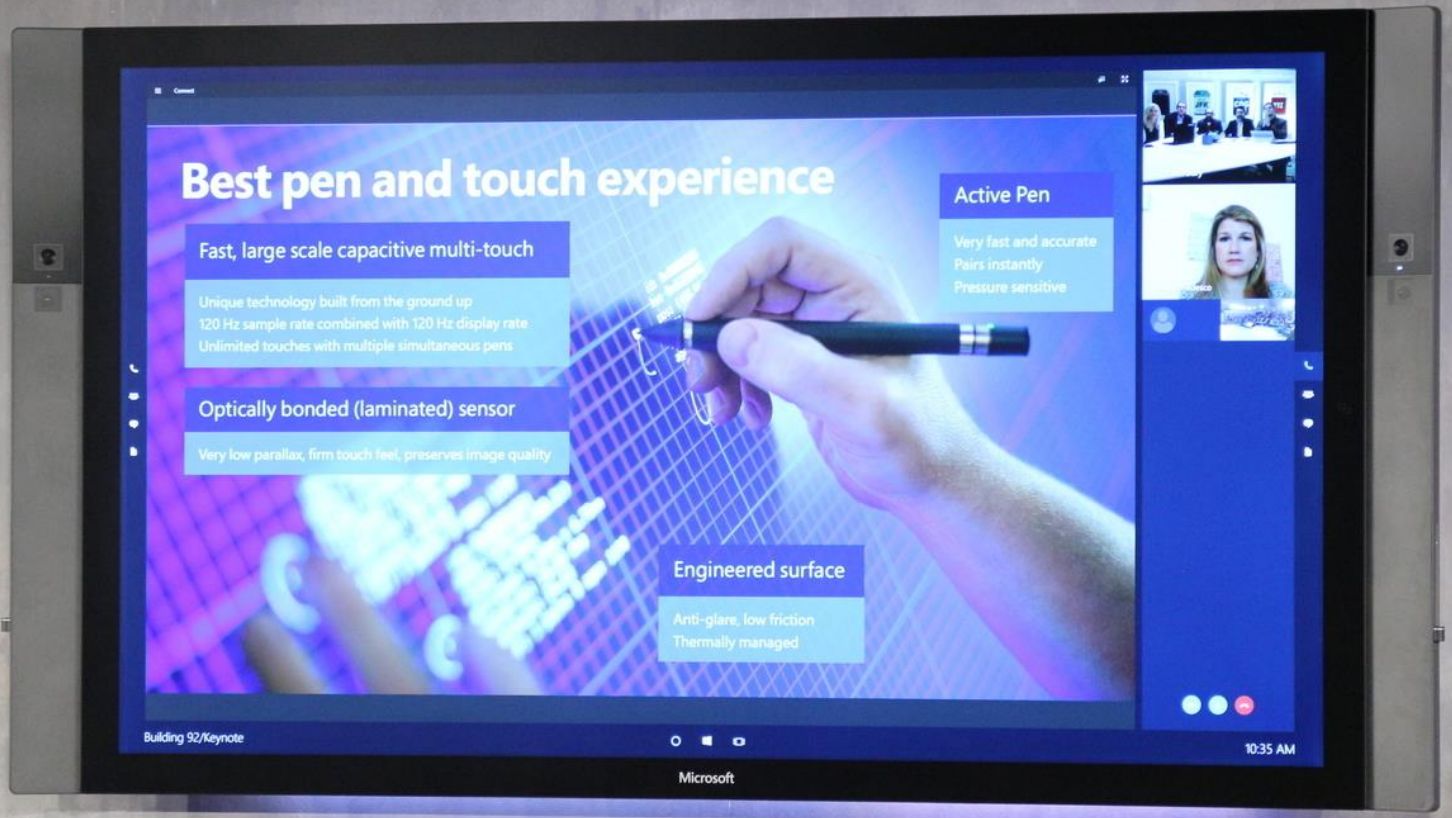
Interesting problems in vision can be solved if they are sufficiently constrained.

Collaborative Office Space

Microsoft

Big Boards &
Massive Office Screens

Microsoft Surface Hub

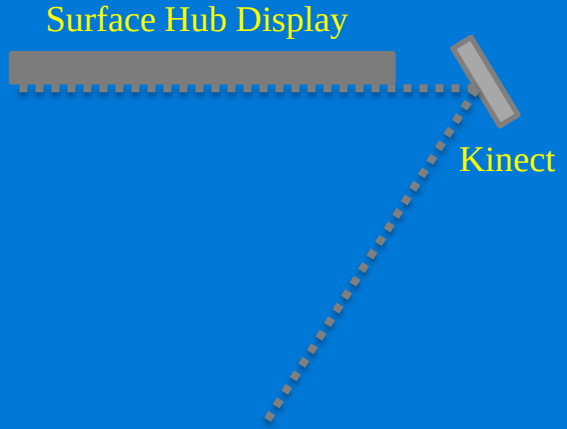


Microsoft

ViiBoard:

Vision-enhanced Immersive Interaction with Touch Board

Experimental Setup



Big Touch Board (Surface Hub) + RGB-D Sensor (Kinect)

leads to more natural and immersive interaction with touch boards

ViiBoard:

Vision-enhanced Immersive Interaction with Touch Board

VTouch

Natural and Rich Interaction Beyond Touch *with important cues from RGB-D sensors*

- Position and proximity w.r.t. Touch Board
- Person ID
- Hand ID
- Gesture ID
- Intention

ImmerseBoard

Immersive Remote Collaboration *as if writing on a physical whiteboard side-by-side*

- Seeing the reference point
- Sharing the same space
- Being aware of gaze
- Predicting intention

Vision-enhanced Touch Experience

VTouch

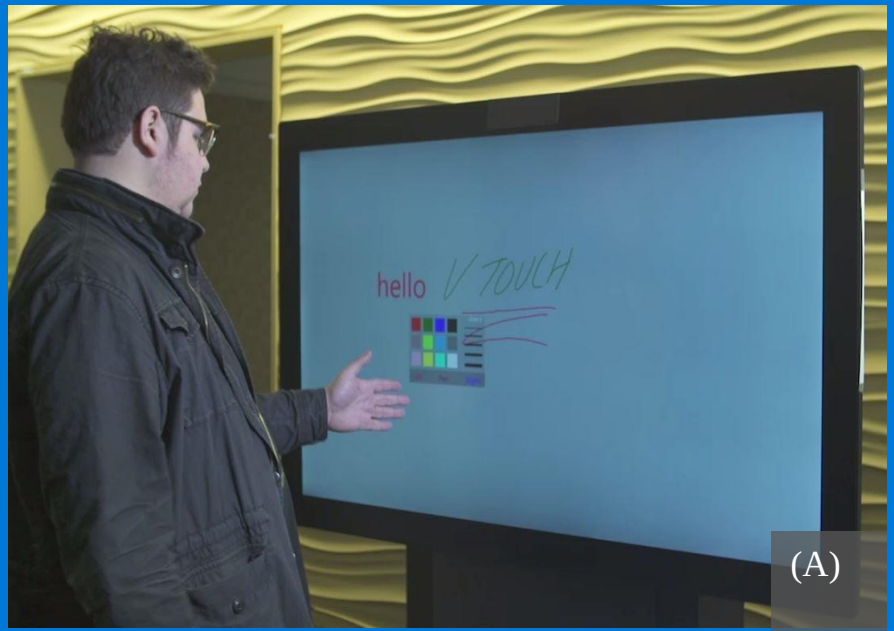
Key Vision Technologies

- Sensor-Display Calibration
- Human Skeletal Tracking
- Hand Gesture Recognition
- Person Recognition

VTouch: Sample applications

- Bring up menu without touch
- Display menu where you are
- Augment touch with
  - **HandID, PersonID, GestureID**
- Hover
- Pointing
- Auto lock of the display
- Auto unlock only with meeting participants

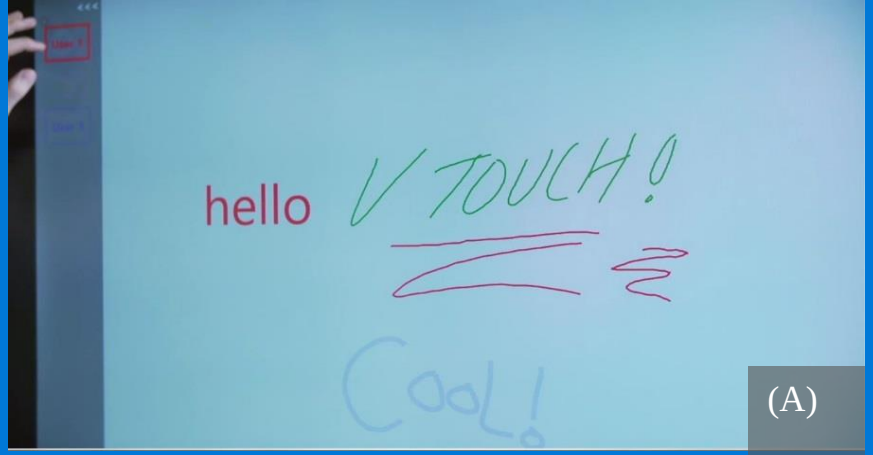
Microsoft



(A)

(B)

Microsoft



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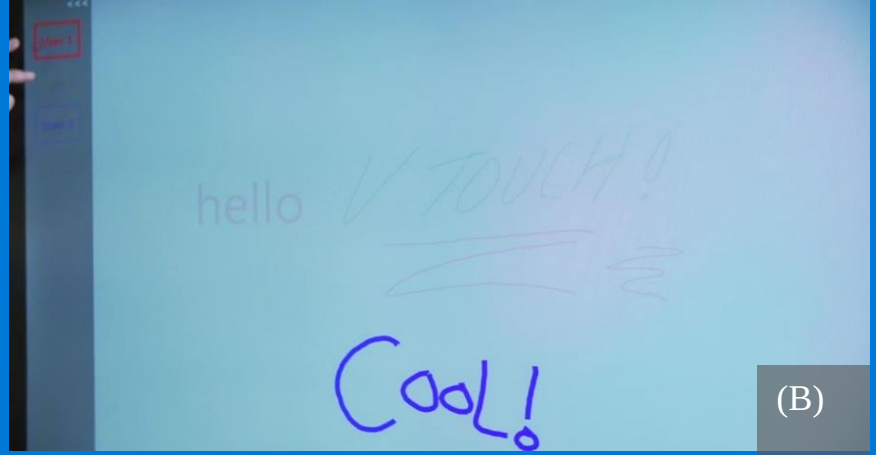

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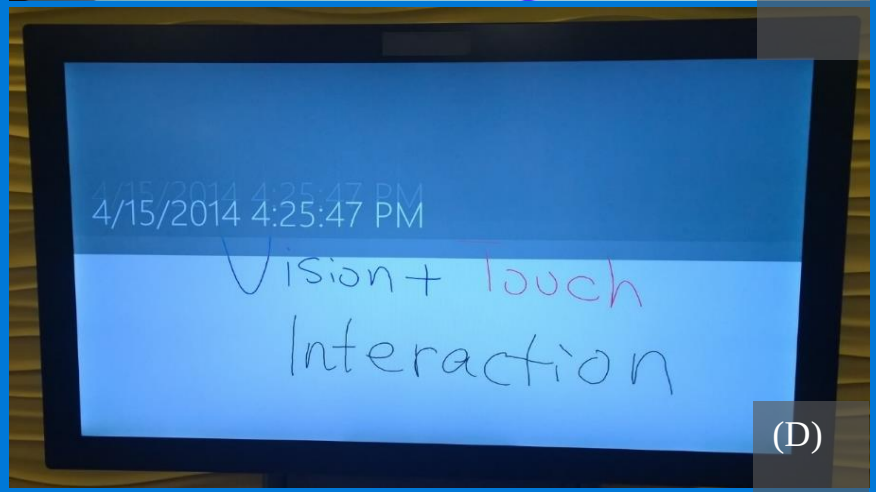
(C)



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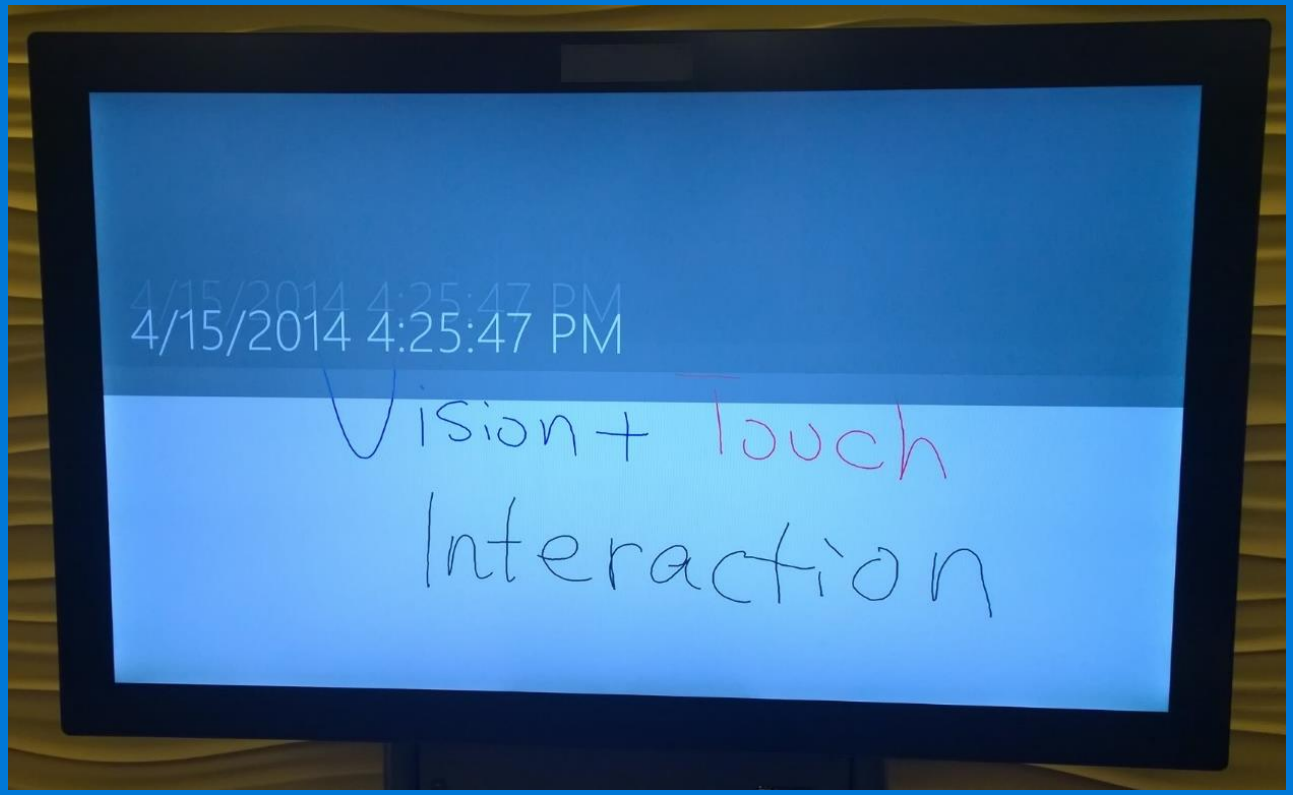
Microsoft



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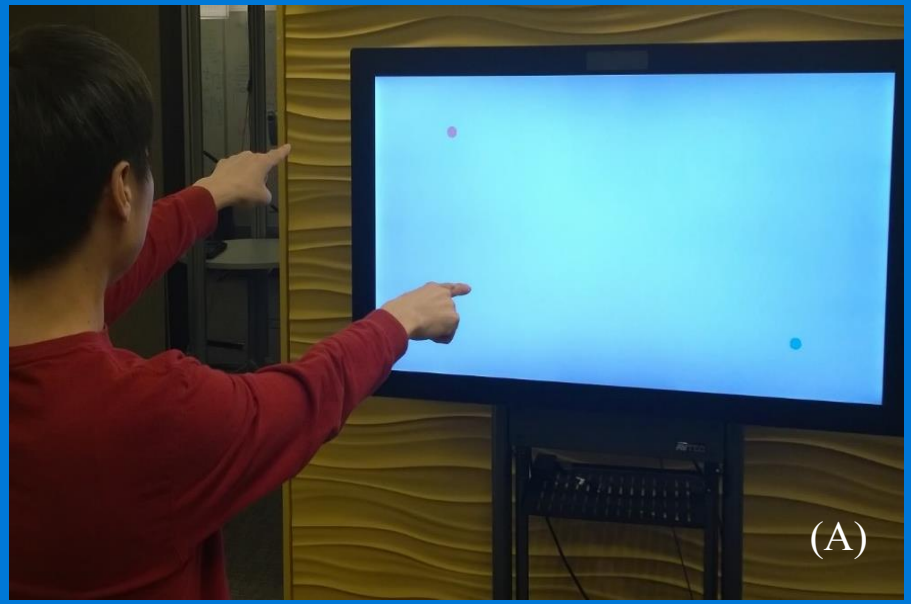

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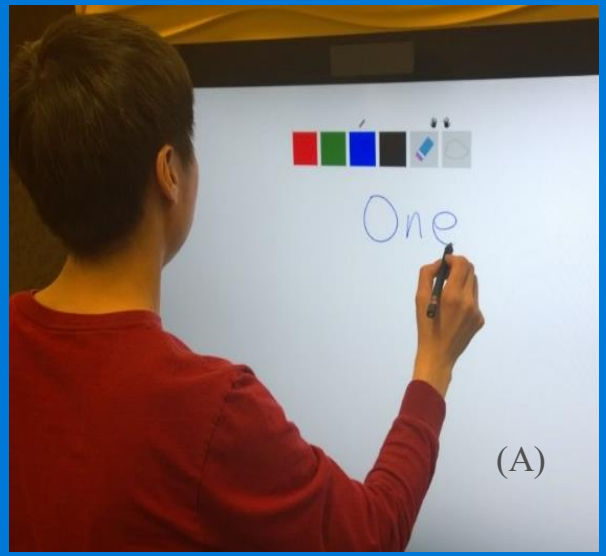
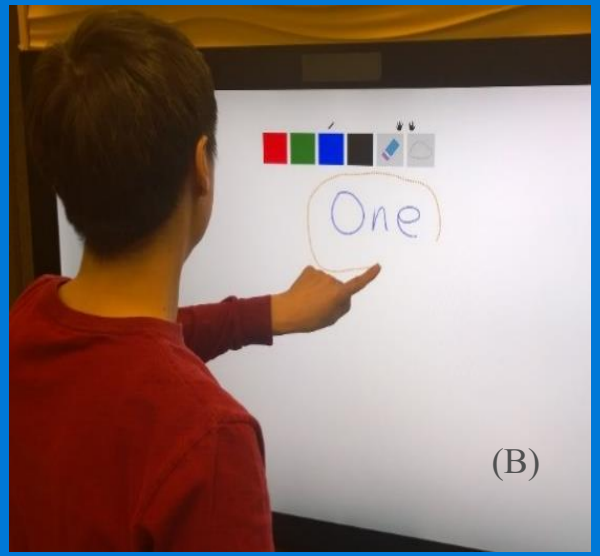


(A)



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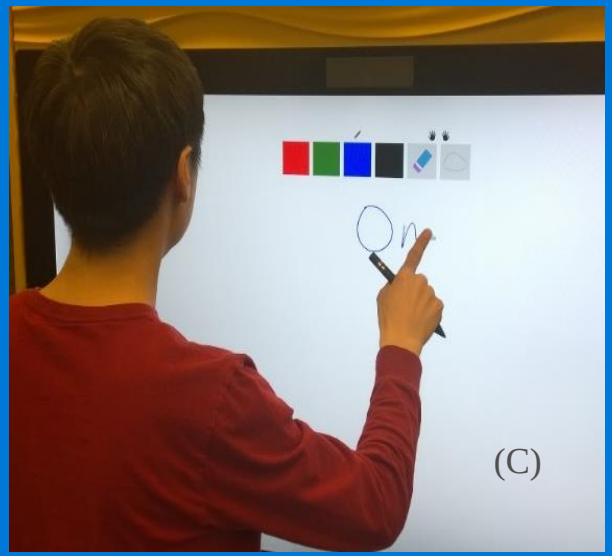

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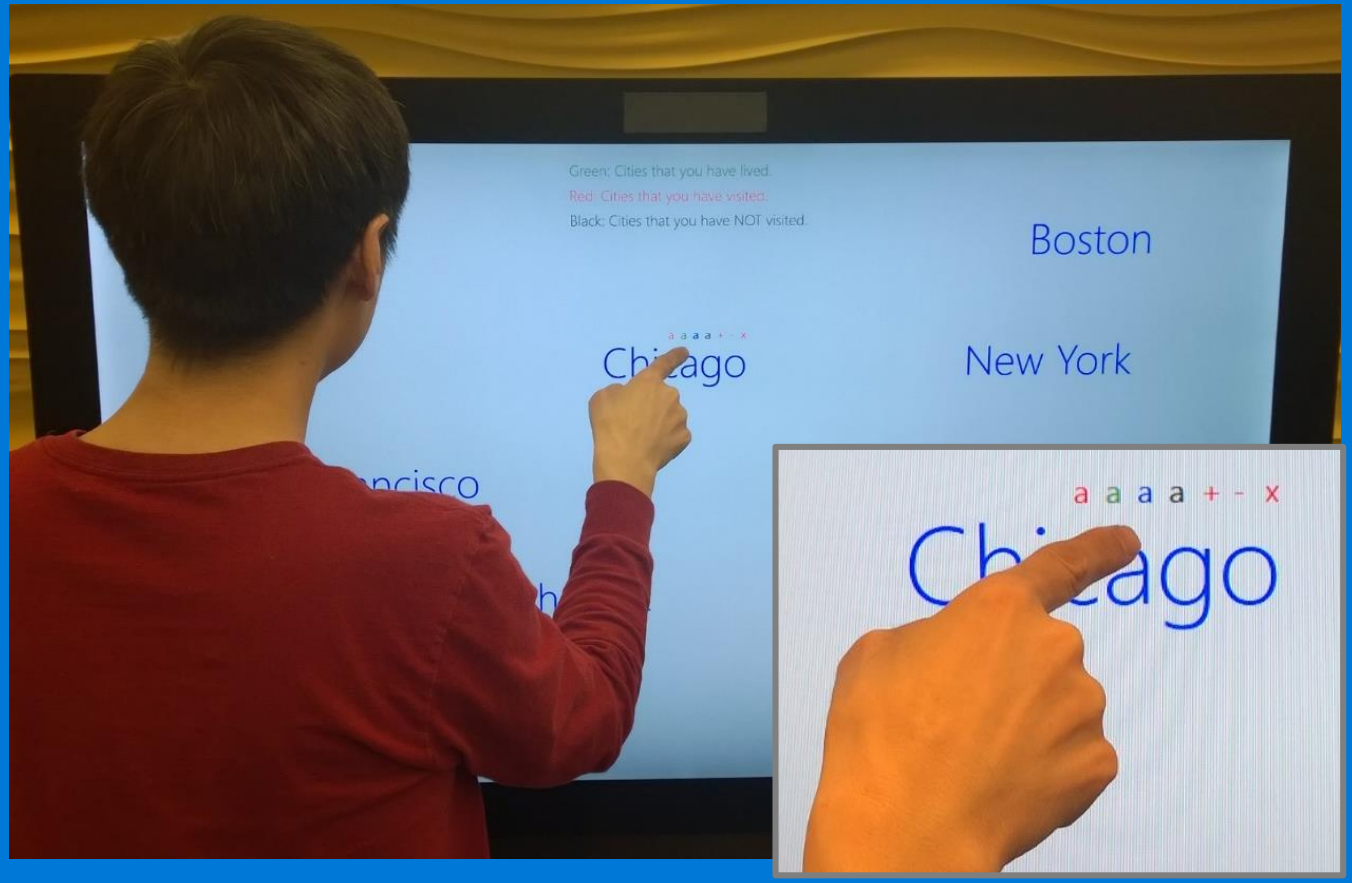
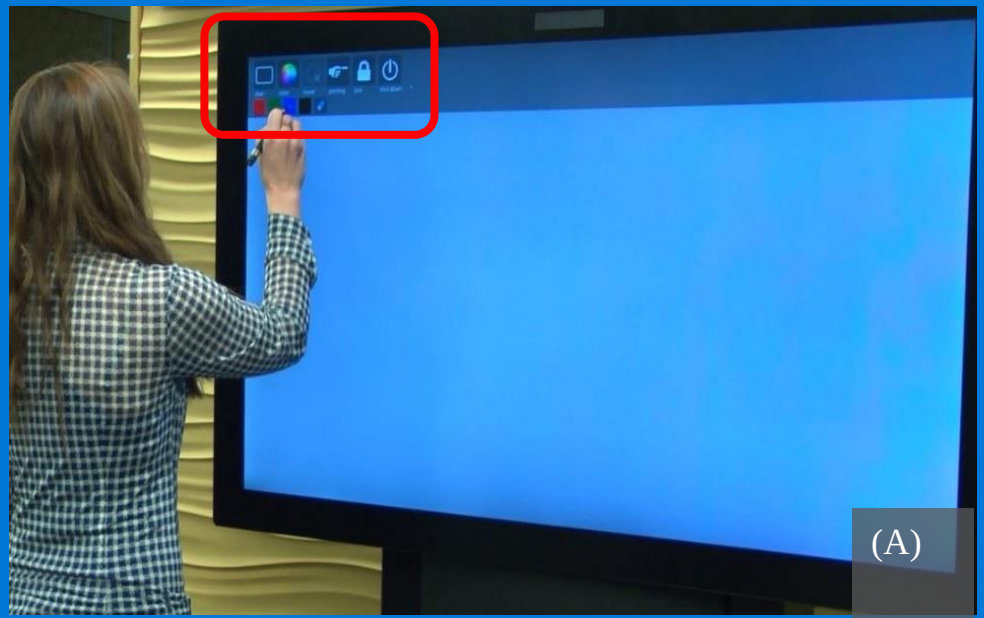
Microsoft


Green: Cities that you have lived.
Red: Cities that you have visited.
Black: Cities that you have NOT visited.
Boston
New York
a a a a + - x

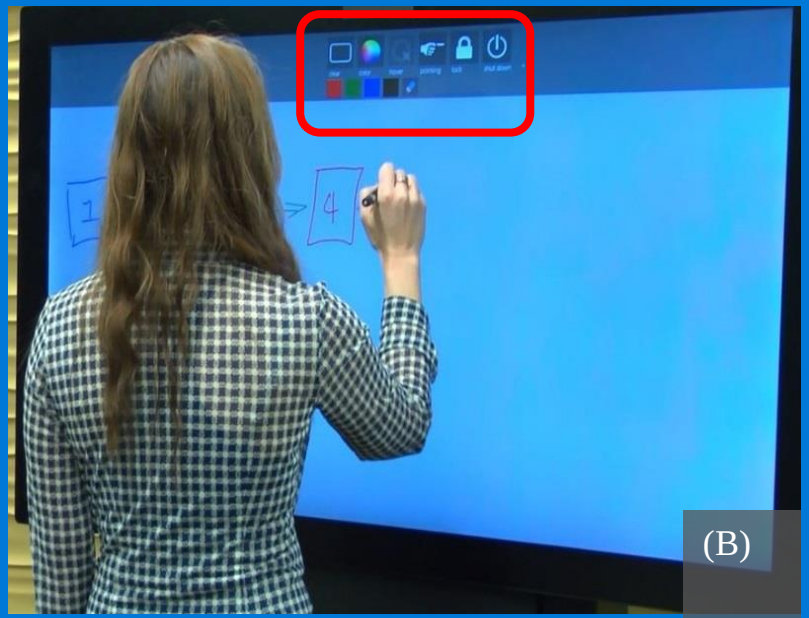
Microsoft

Menu Buttons



(A)

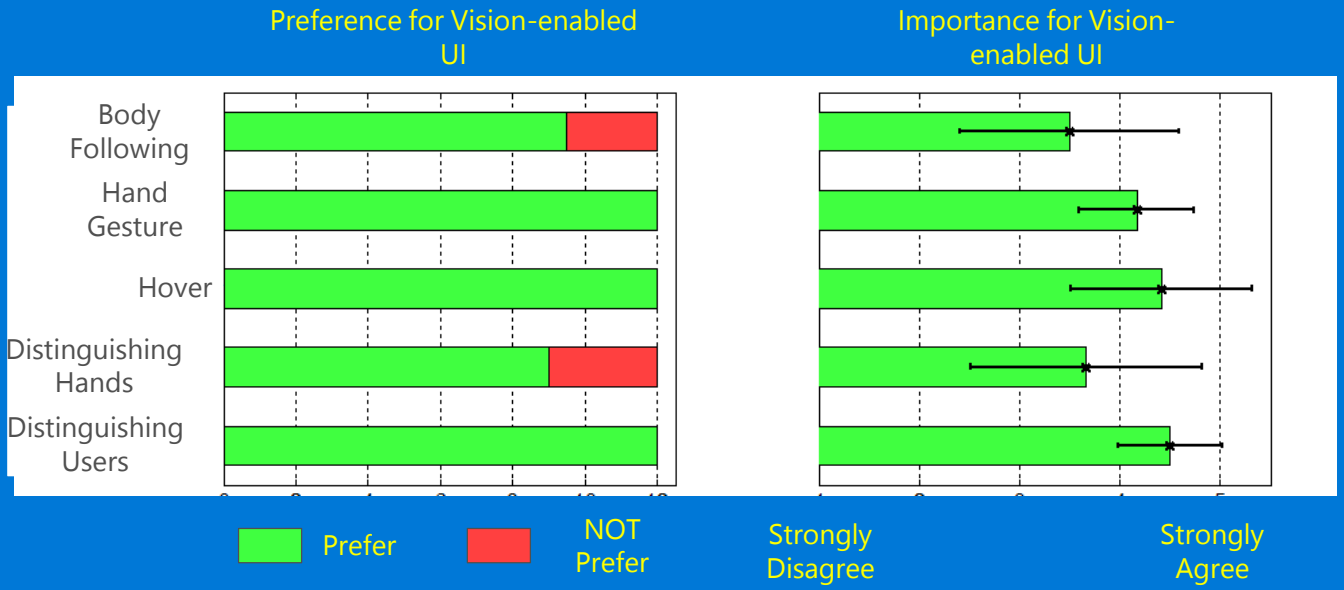
Menu Buttons



(B)

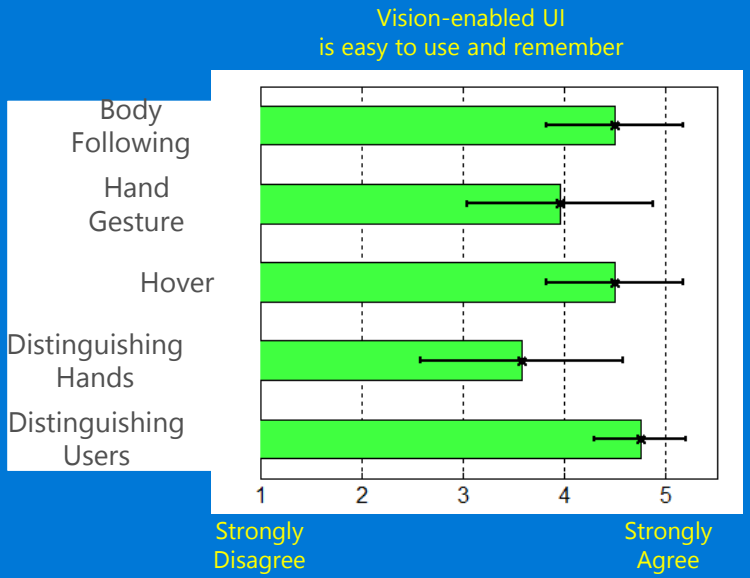
Microsoft

User Study



Microsoft

User Study



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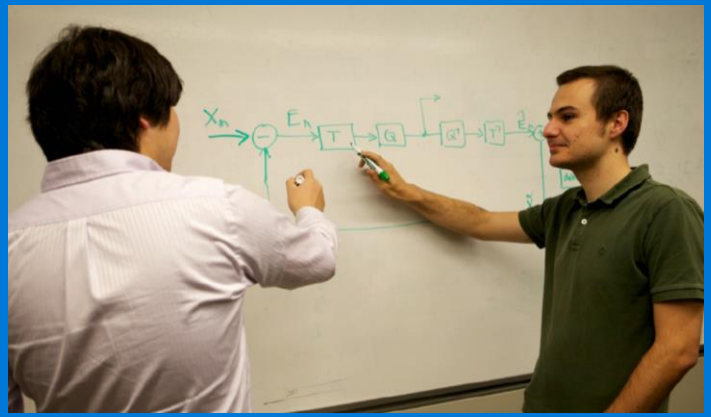
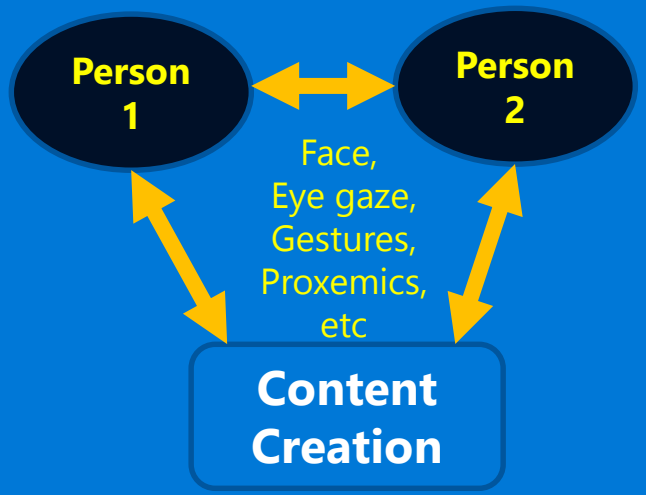
Vision-enhanced immersive remote collaboration

ImmerseBoard

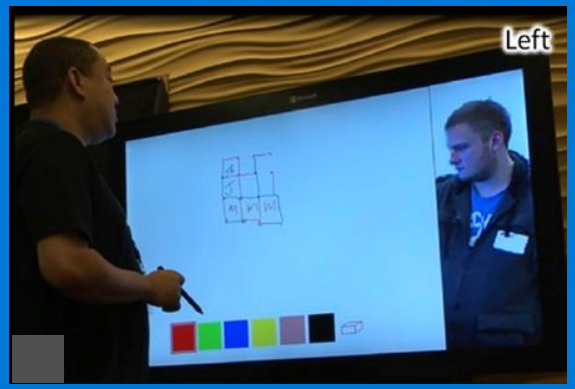
Co-located Collaboration

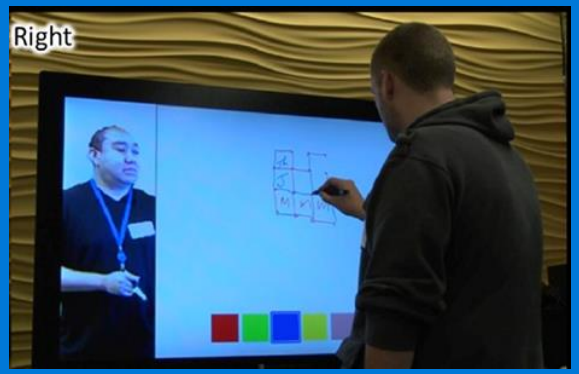
- Physical whiteboard

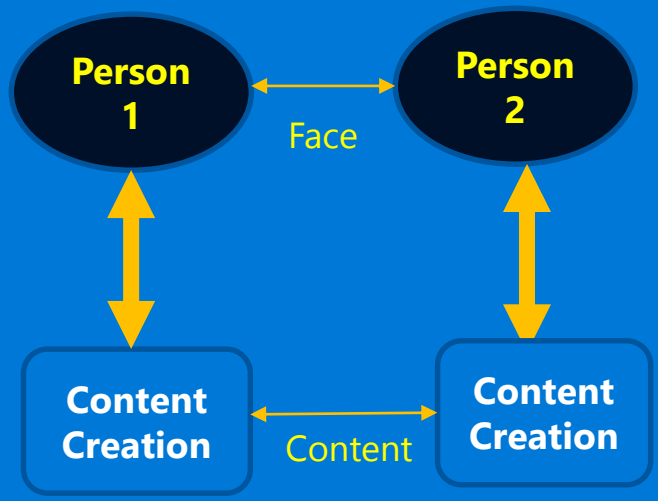




Remote Collaboration: Now







Microsoft

RGBD Sensor (Kinect) + Touch Board (Surface Hub)
= Immersive Remote Collaboration

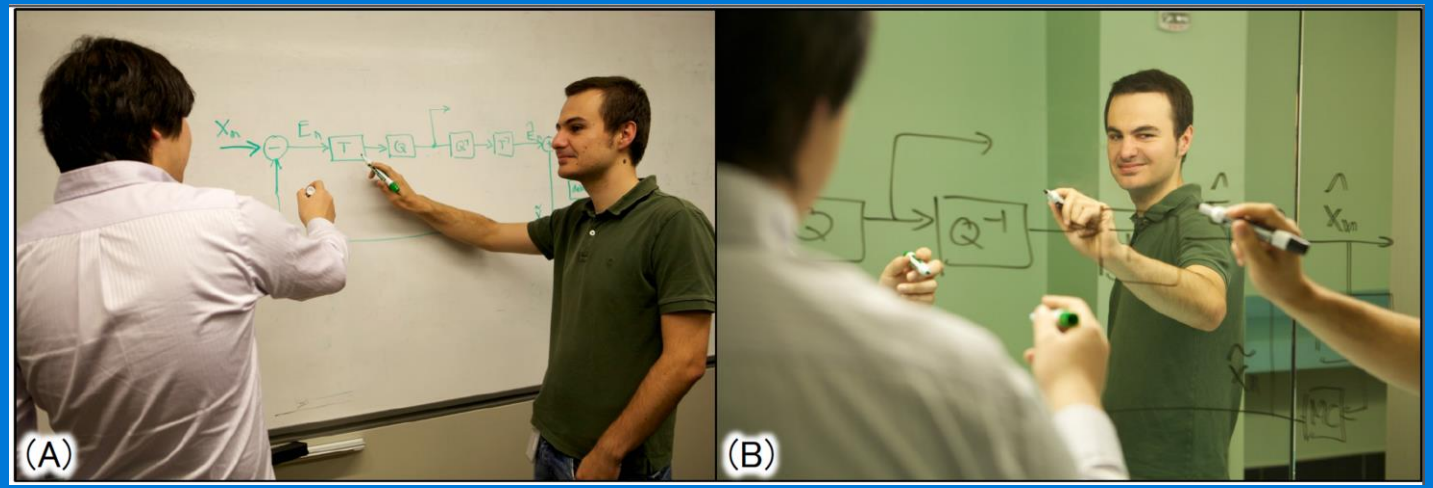
as if writing on a physical whiteboard side-by-side

- Seeing the reference point
- Sharing the same space
- Being aware of gaze
- Predicting intention

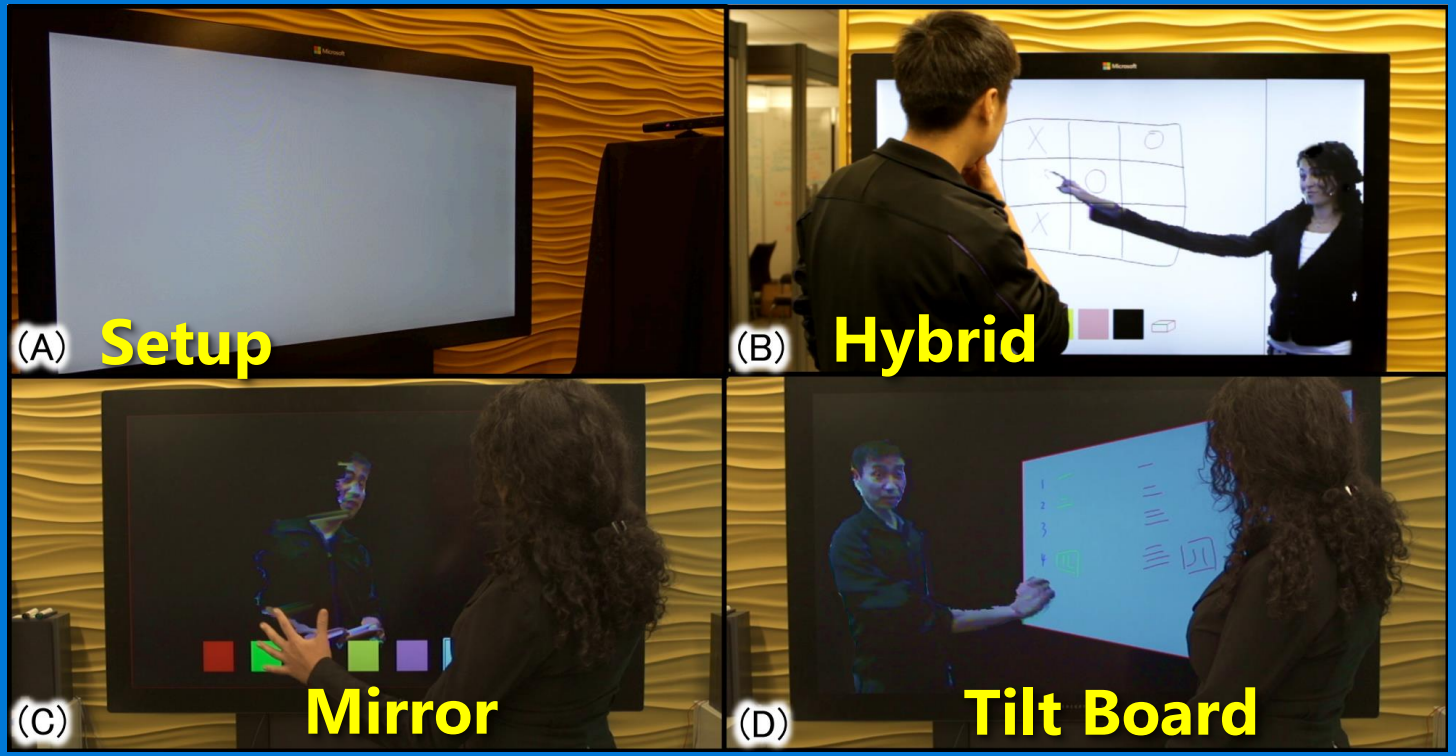
Two Metaphors

Side-by-side writing

on a whiteboard *on a mirror*



ImmerseBoard: Implemented Conditions



ImmerseBoard

Natural Remote Collaboration

ViiBoard:

Vision-enhanced Immersive Interaction with Touch Board

Big Touch Board (Surface Hub) + RGB-D Sensor (Kinect)

leads to more natural and immersive interaction with touch boards

VTouch

Natural and Rich Interaction Beyond Touch

with important cues from RGB-D sensors

- Position and proximity w.r.t. Touch Board
- Person ID
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ImmerseBoard

Immersive Remote Collaboration

as if writing on a physical whiteboard side-by-side

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- Predicting intention

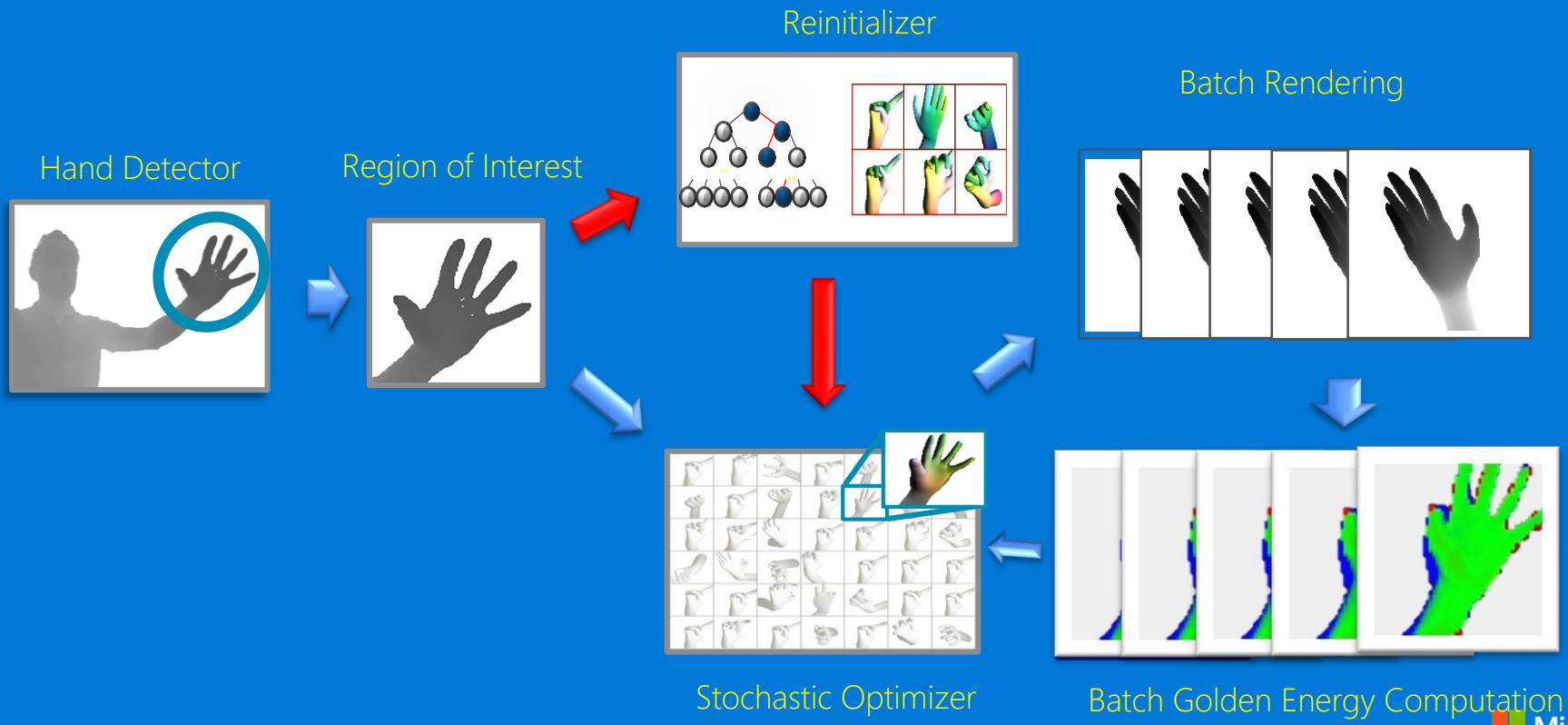
Additional Projects from MSRC

Effective (Hand) Shape And Pose Inference from Depth Images

Varun Ramakrishna
Aaron Hertzmann
Toby Sharp
Cem Keskin
Duncan Robertson
Jonathan Taylor
Jamie Shotton
Ido Leichter
Alon Vinnikov

Richard Stebbing
Sameh Khamis
David Kim
Christoph Rhemann
Yichen Wei
Daniel Freedman
Eyal Krupka
Andrew Fitzgibbon
Shahram Izadi

Architecture



Microsoft


DELL

Understanding Reality for Generating Credible Augmentations

Pushmeet Kohli

Microsoft Research

1: Labelling Point Clouds

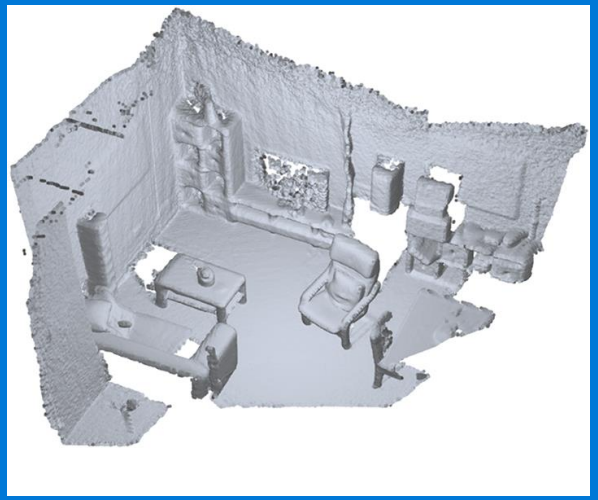
[With Shapovalov et al. CVPR ‘12]

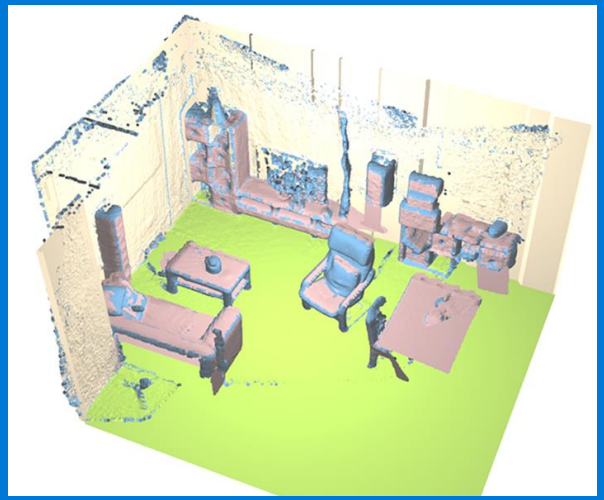
Inference Machine
=
Extension of
Random Forests

Colours represent different
object categories

2. Scene Completion

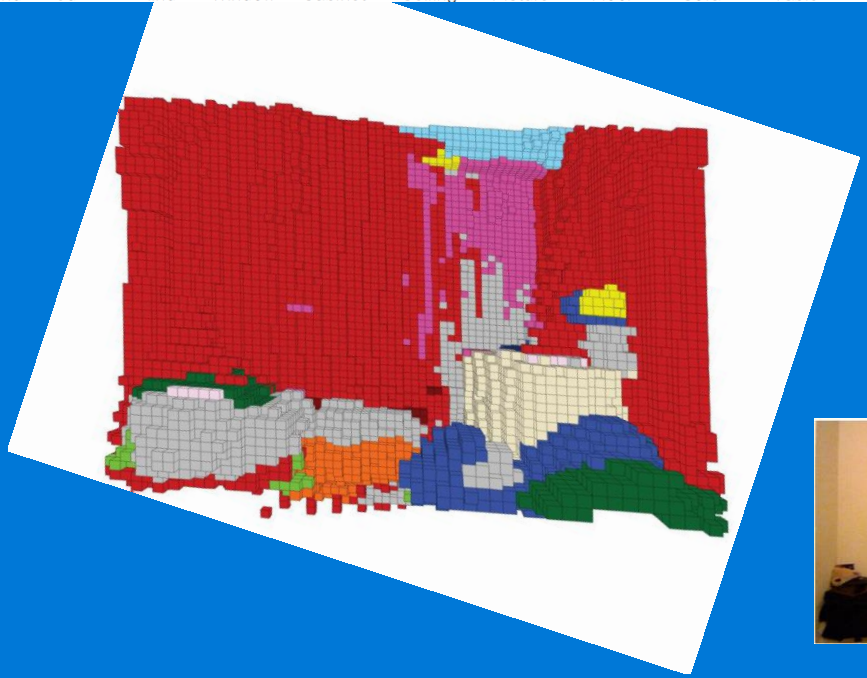
[Silberman, Shapira, Gal, Kohli, ECCV 2014]





3. Semantic Labelling through Voxel CRF

[Kim, Kohli, Saverese, ICCV 2013]



Microsoft

4. Inferring Support Relationships

[Silberman, Hoiem, Kohli, Fergus, ECCV 2012]

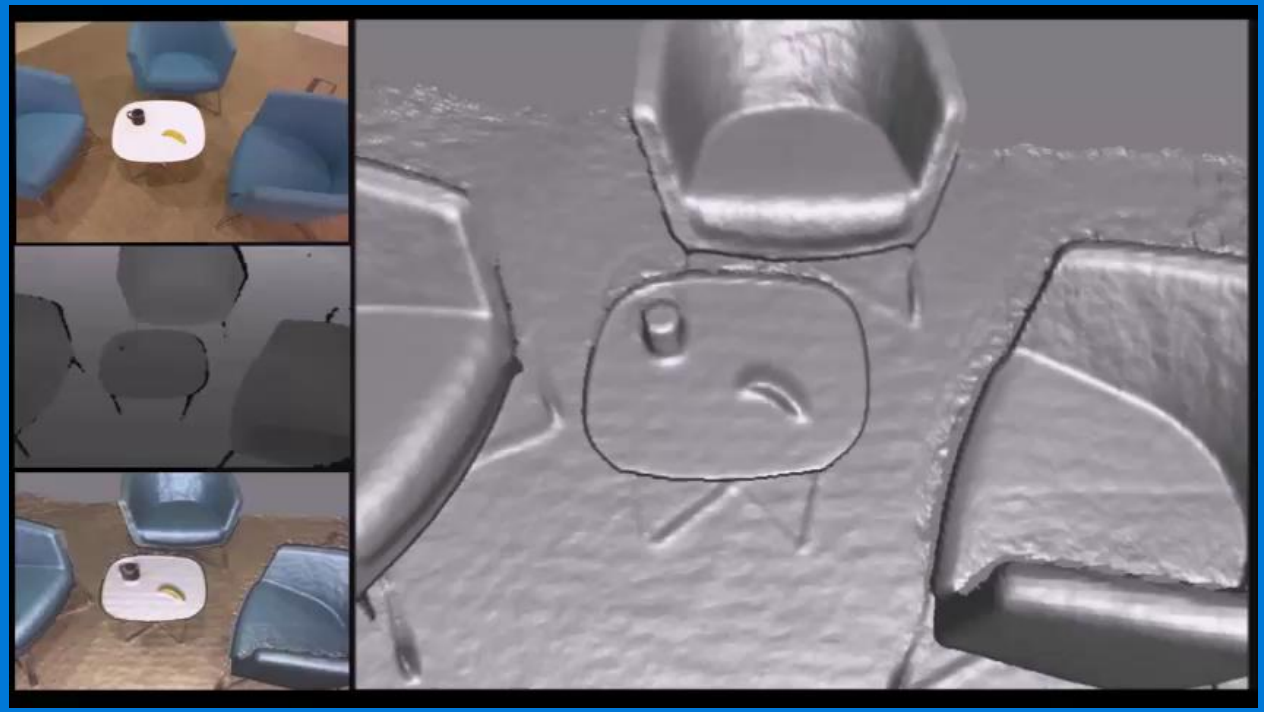
Interacting with objects requires understanding of support relationships!!

Can I move the book?

5. Dynamic Capture and Labelling

[With Oxford Brookes, Shahram Izadi, TOG 2015]

Video



Microsoft