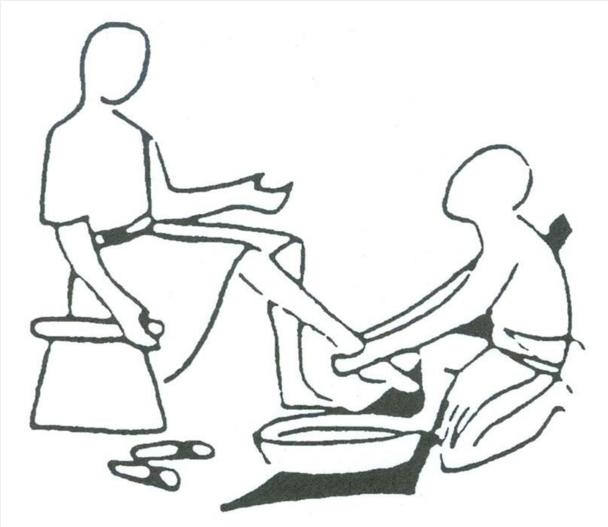
Context-aware Intelligent Assistant

Sabir Akhadov 2015

Assistance



Servant

Valet

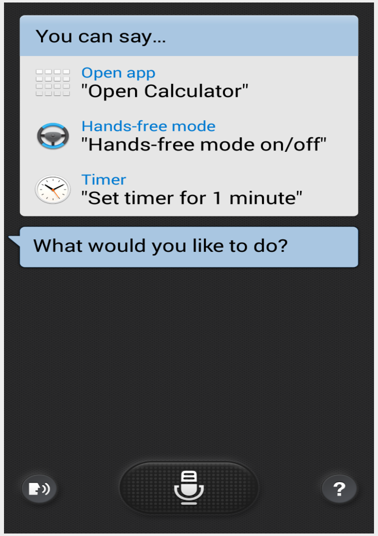
Secretary

Intelligent Assistant

Siri

Google now

S Voice



[15]

Intelligent Assisting Devices

Amazon Echo

WIMM One

[16]

AR Intelligent Assisting Devices

Google Glass

CastAR

Moverio BT-200

[15], [16], [17]

AR Intelligent Assisting Devices

Privacy concerns

- What is recorded?
- Where does the data go?
- What is done with it?
- Who can see it?

[18]

Context

Where you are

Who you are with

What resources are nearby

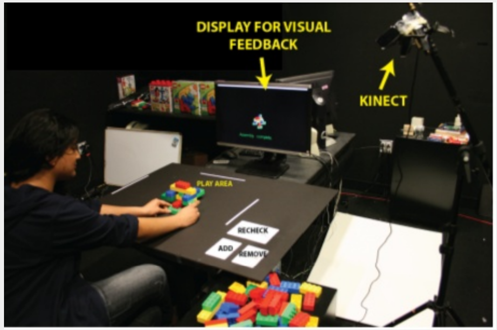
[4], [6]

Context-aware Intelligent Assistant

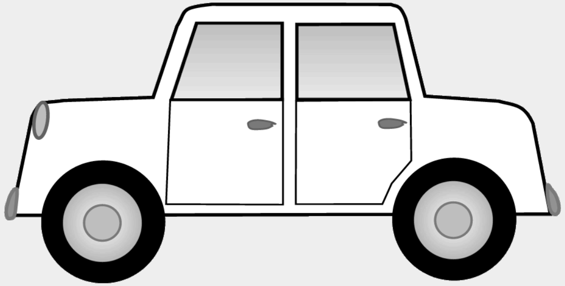
- Recognize current context of the situation
- Use context to help with a task
- Make predictions about the future

Road map

Tracking of manual workflows



Guiding Block Assembly



Situation Awareness for In-Car Recommendations

enactive

proactive

Real-time Modeling and Tracking Manual Workflows from First-Person Vision

German Research Center for Artificial Intelligence (DFKI)

[1]

Goal

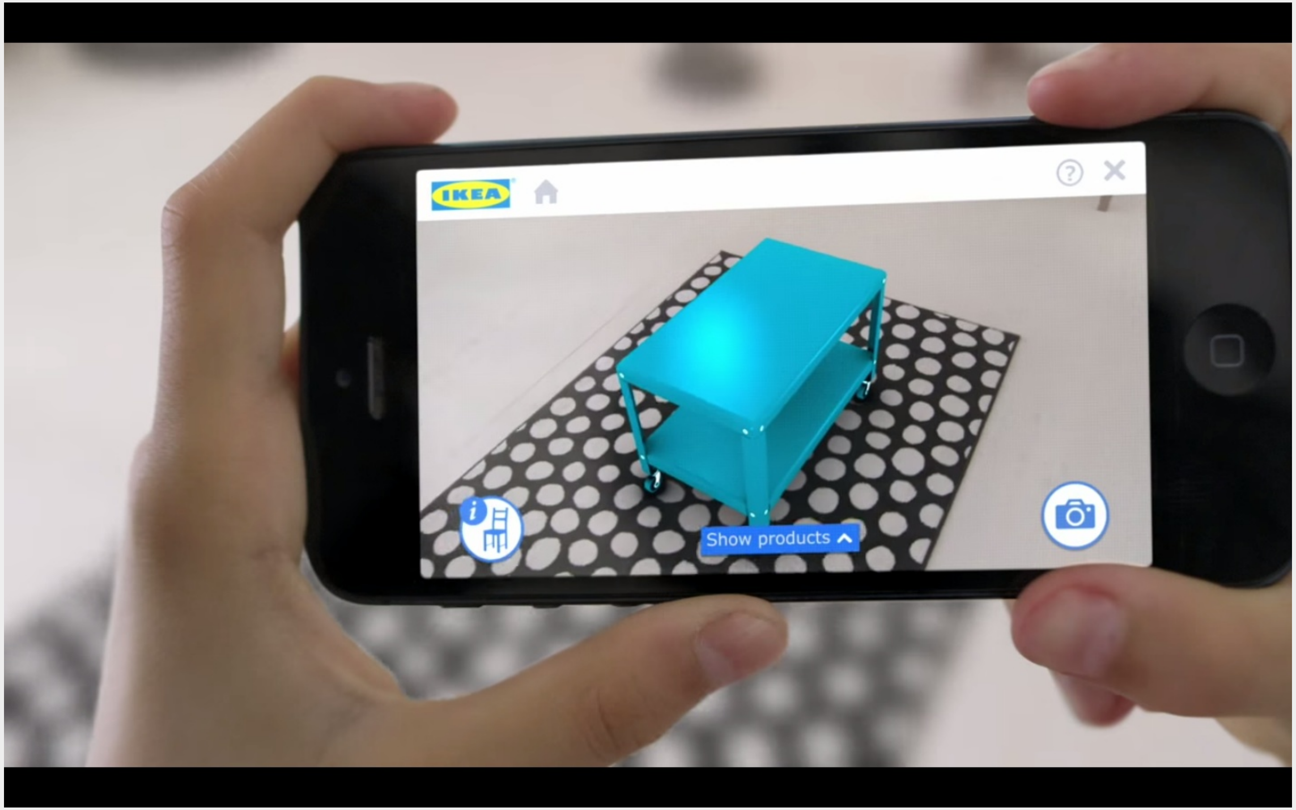
- Augmented Reality manuals
- Follow the progress of a user
- Show the next steps
- Indicate errors

Introduction

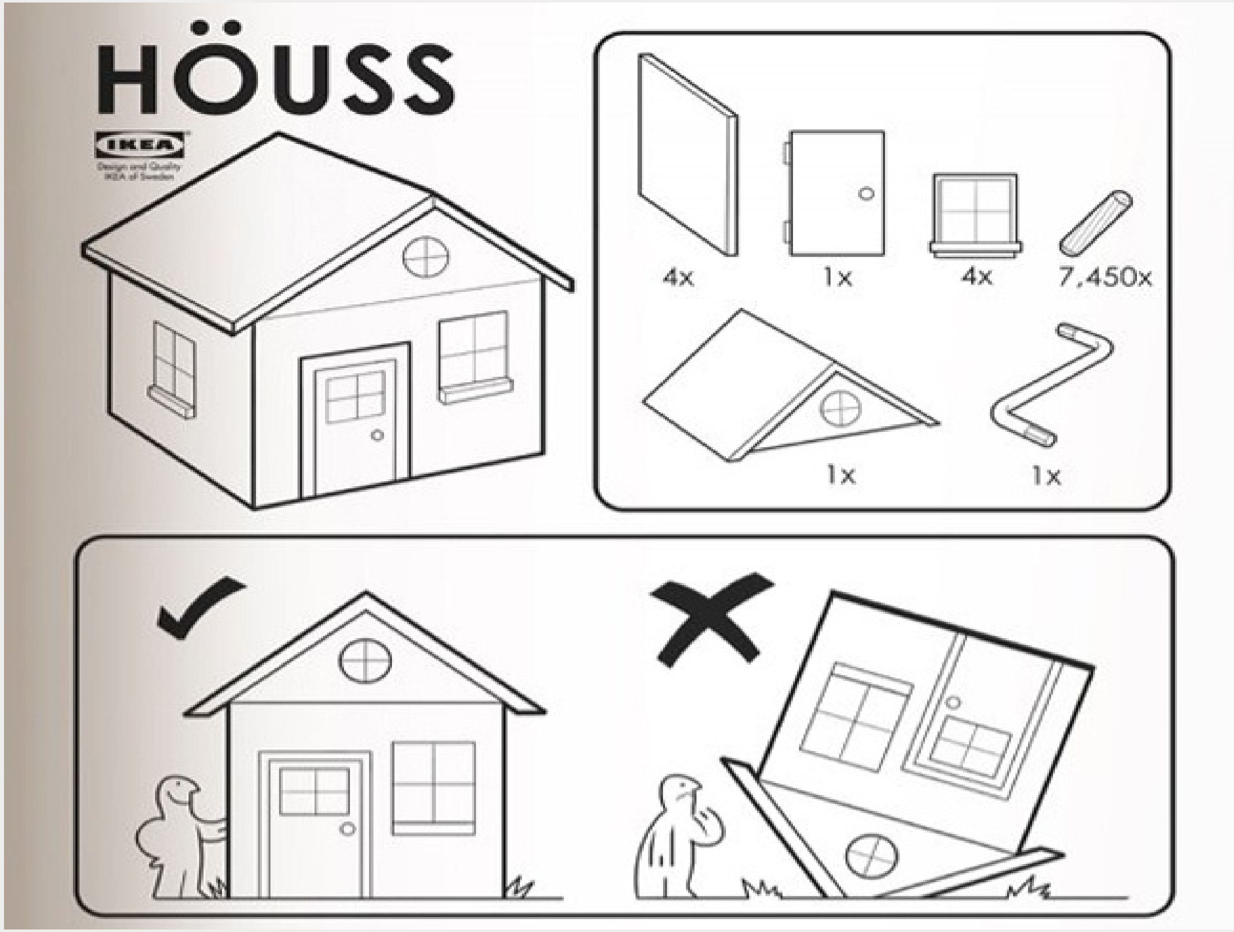
Real-time Modeling and Tracking Manual Workflows from First-Person Vision

Ikea Catalog

See furniture installed in your apartment



Ikea Manual



AR manual

Introduction

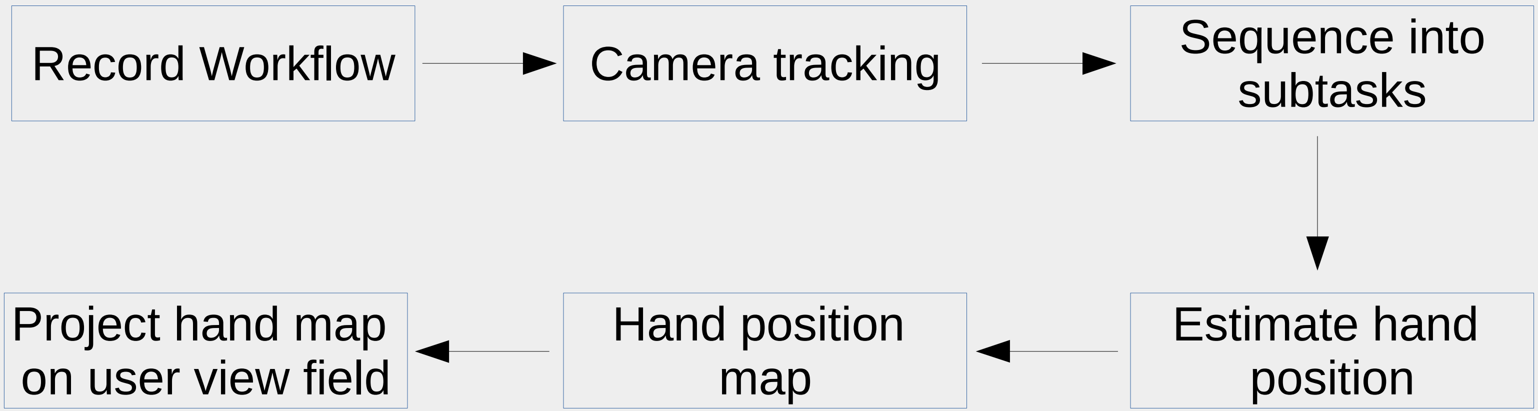
Real-time Modeling and Tracking Manual Workflows from First-Person Vision

Approach

- Record with head-worn camera
- Analyze video sequences
- Record hands position during training
- Show the hand position for enactive feedback*
- Provide optical validation

*enactive feedback – there is an ongoing interaction between user action and the system

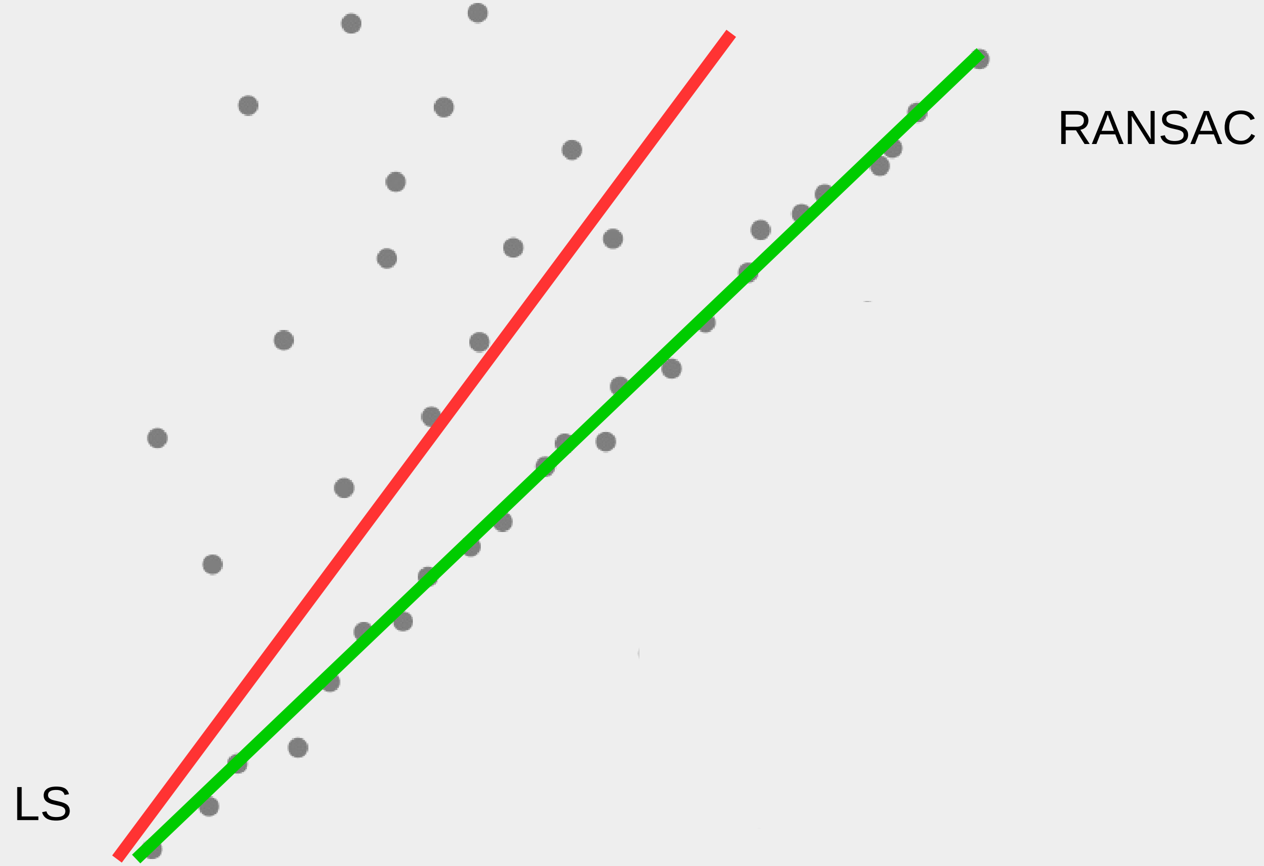
Process diagram



Camera tracking

- Initialization:
  - Select arbitrary corner features.
  - Find correspondences in the next frame with KLT
  - Use RANSAC to find the largest subset P which can be described using a homography H
  - The subset P is used at a later step

RANSAC



[5], [8]

Camera tracking

- Work step
  - P as input from previous frame
  - Use KLT and RANSAC to find next H
  - Find new corner features across the entire image
  - Find correspondences in the next frame and reject points that cannot be described with H

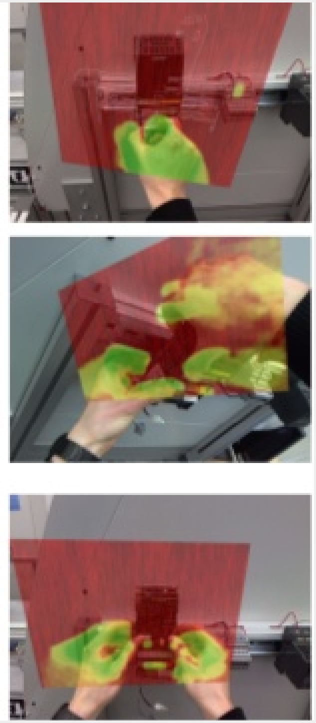
Task segmentation

- Image difference function:

$$d(I1, I2) \rightarrow R$$

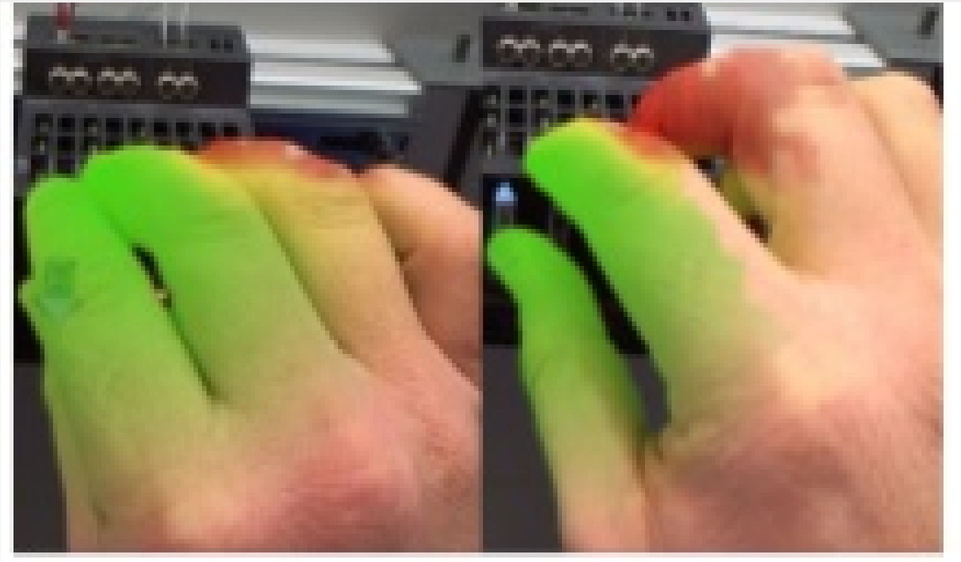
- Strong camera movement:
  - Translation
  - Rotation

Hand position



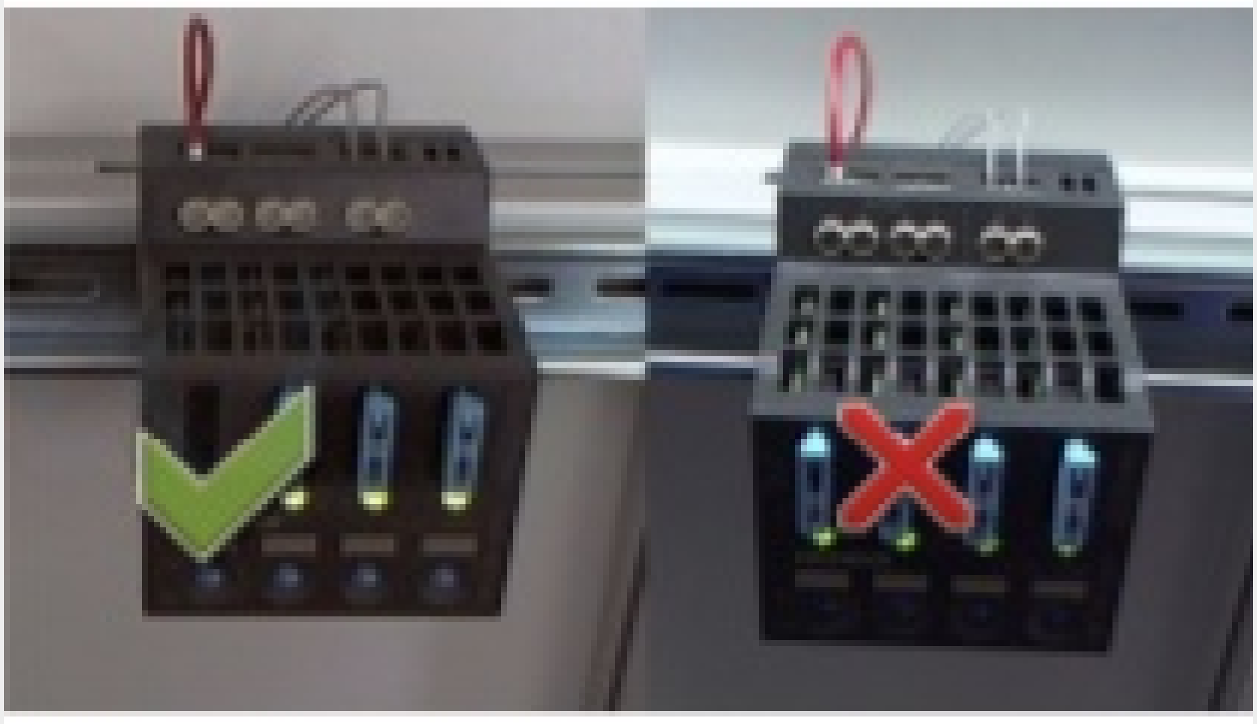
Application

Enactive feedback



Application

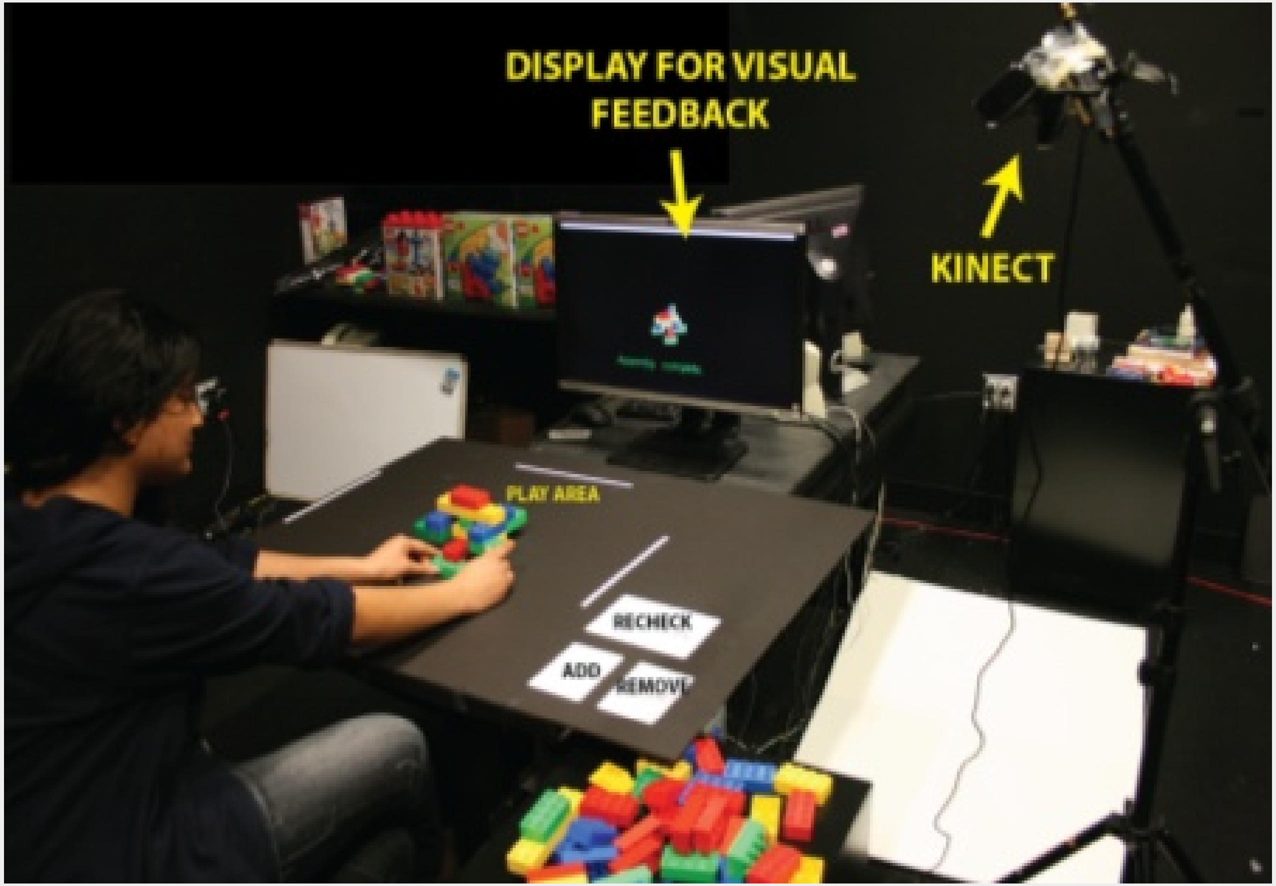
Optical validation



Conclusion

- Depth inferred from video sequences
- This approach works only in static environment
- Different lighting may be a problem

DuploTrack: A Real-time System for Authoring and Guiding Duplo Block Assembly



[2]

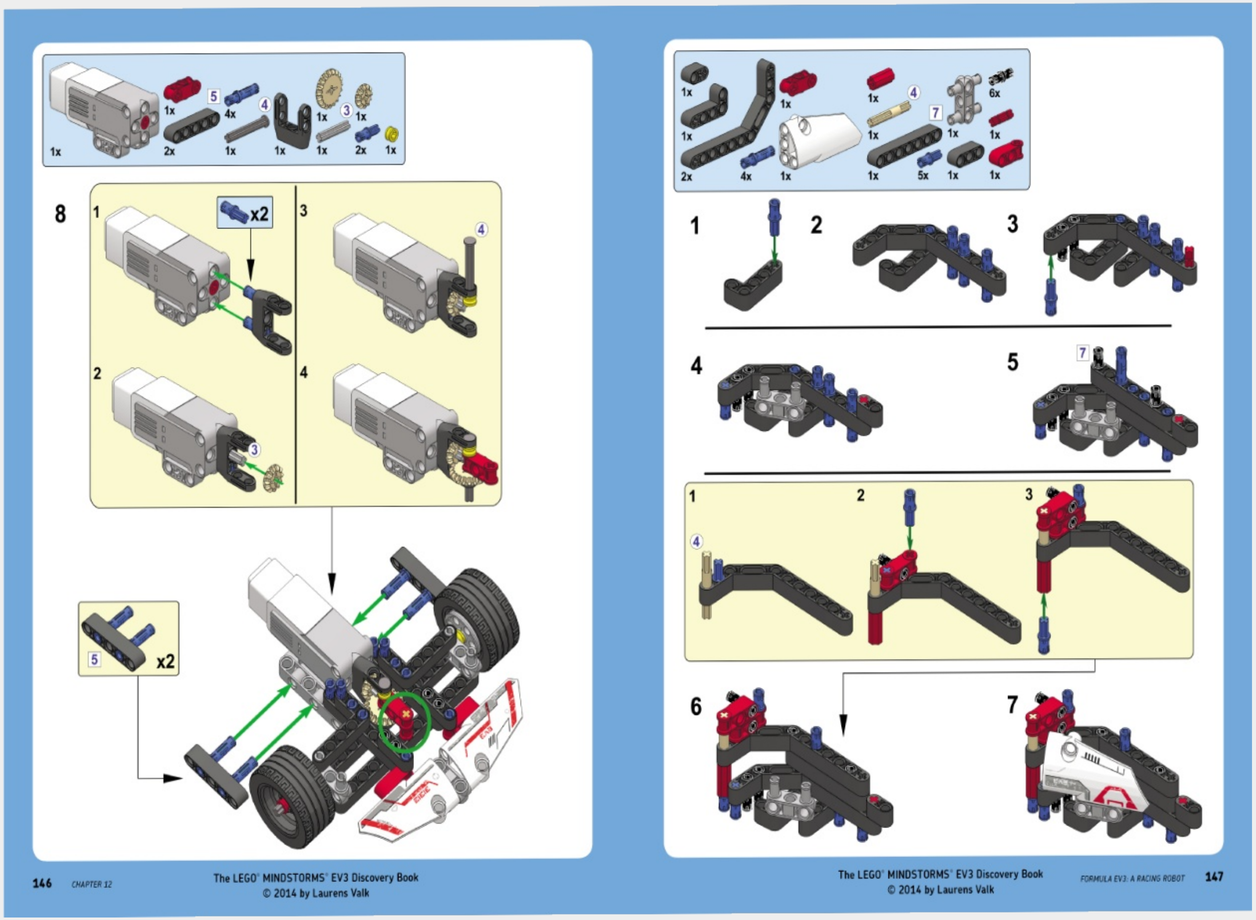
Goal

- Produce assembly manuals
- Track user actions
- Show next step
- Detect mistakes

Traditional manuals

Figure-based:

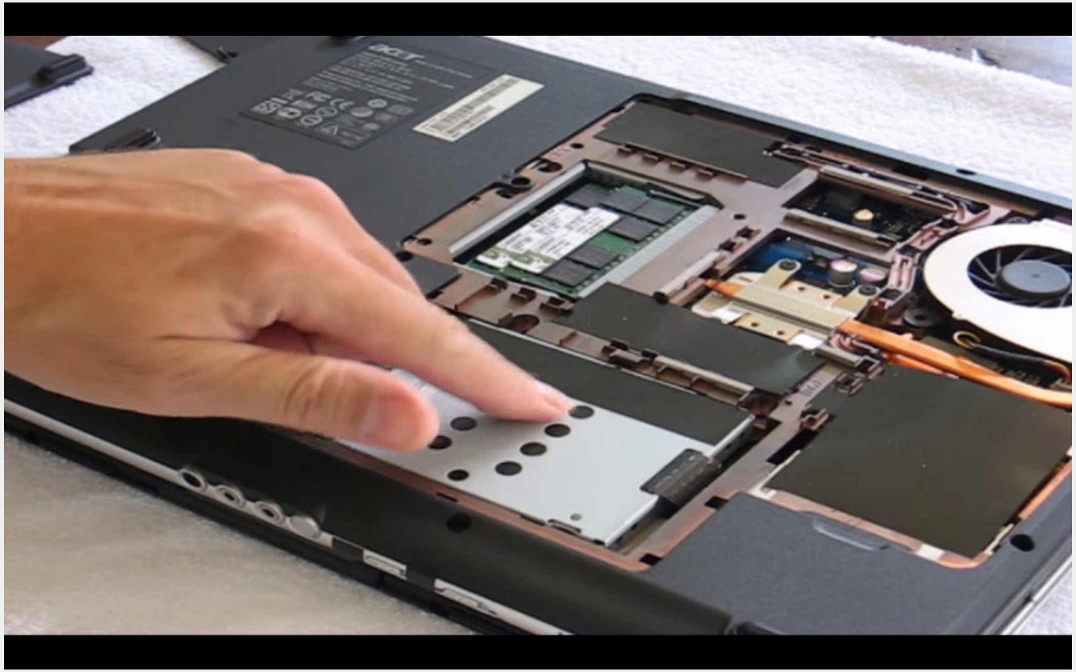
- Difficult to create
- No motion cues



Traditional manuals

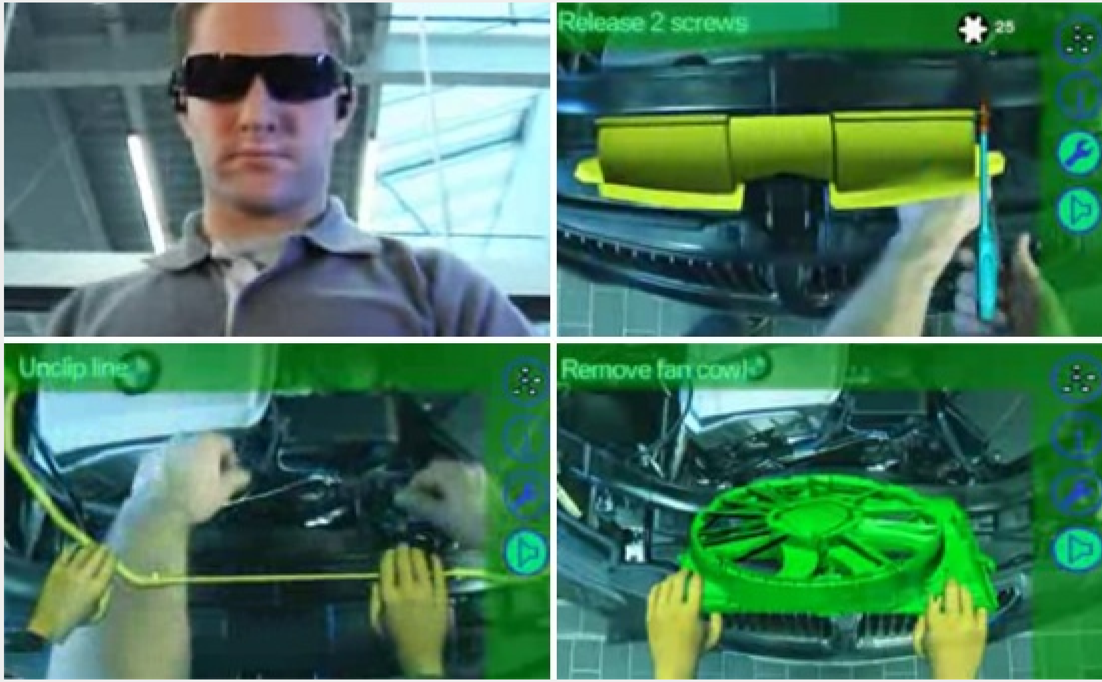
Video based

+ Pause, repeat
+ Motion cues
– Possibly different view point
– Still no feedback



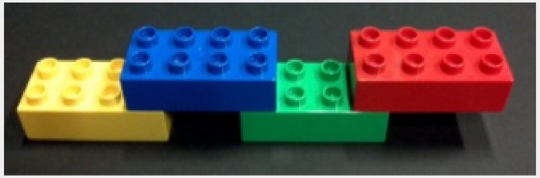
Augmented Reality

- Expensive equipment needed
- Static models
- Motion cues from head motion only



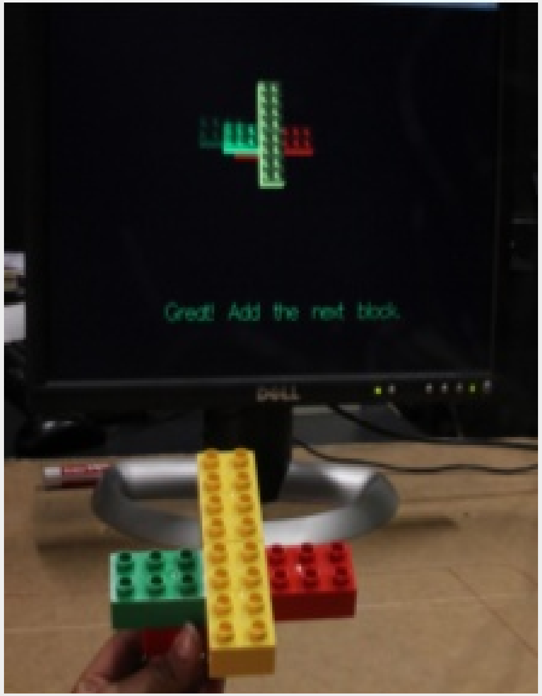
[19]

Overview

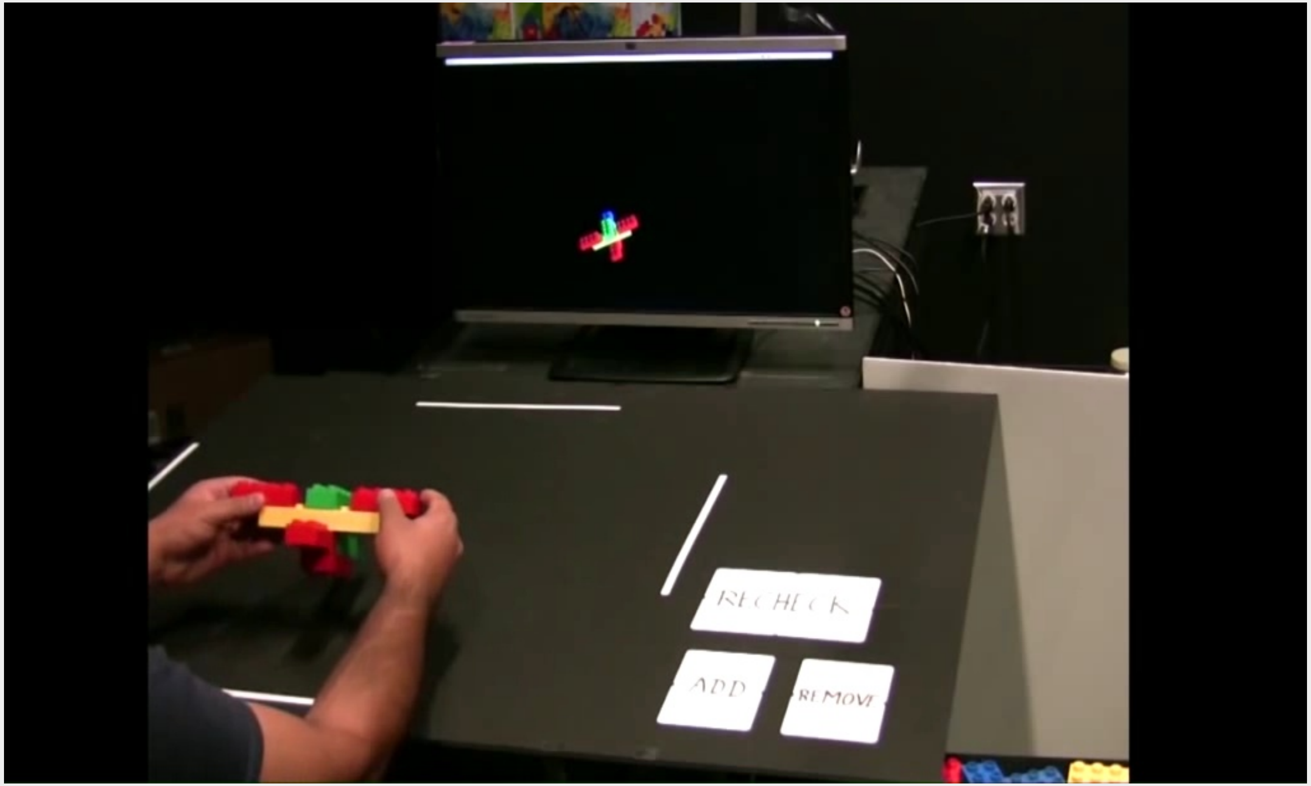


Authoring

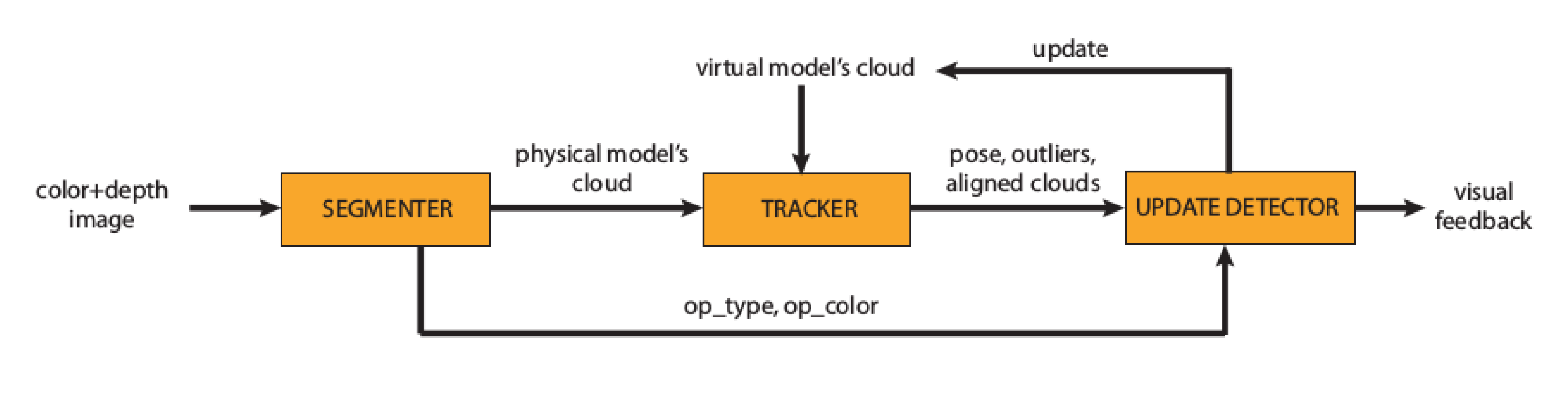
Guiding



DuploTrack Demonstration



Processing pipeline



Tracking the model

- User may rotate and shift model in the Play area
- Lose of tracking if turned upside down
- The point cloud is aligned with virtual model
  - Iterative Closest Point (ICP)

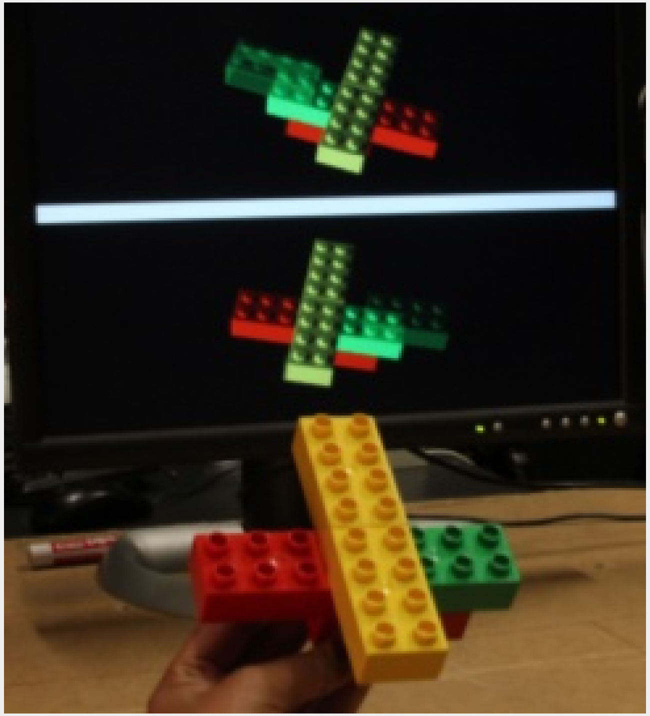
Model tracking at the beginning

- Poor tracking for models with under 5 blocks
  - Noise from Kinect
  - Outliers overwhelm the points before an update
- Solution: Place the model on the table before reaching 5 blocks

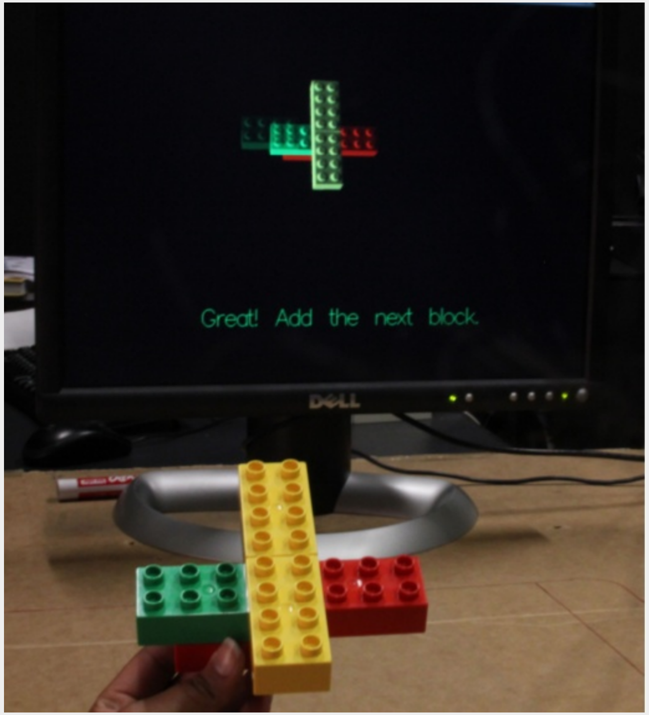
User study

Test guidance system

Baseline

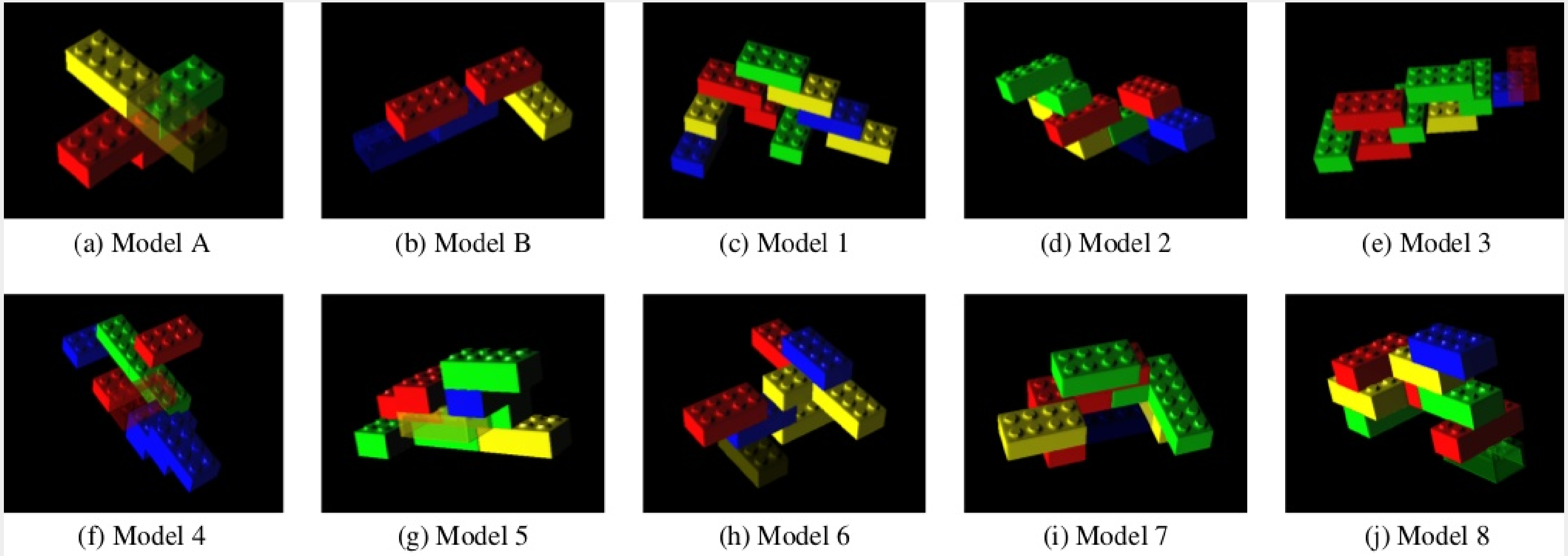


Track



User study, Two Tasks

Single block and multiple blocks addition



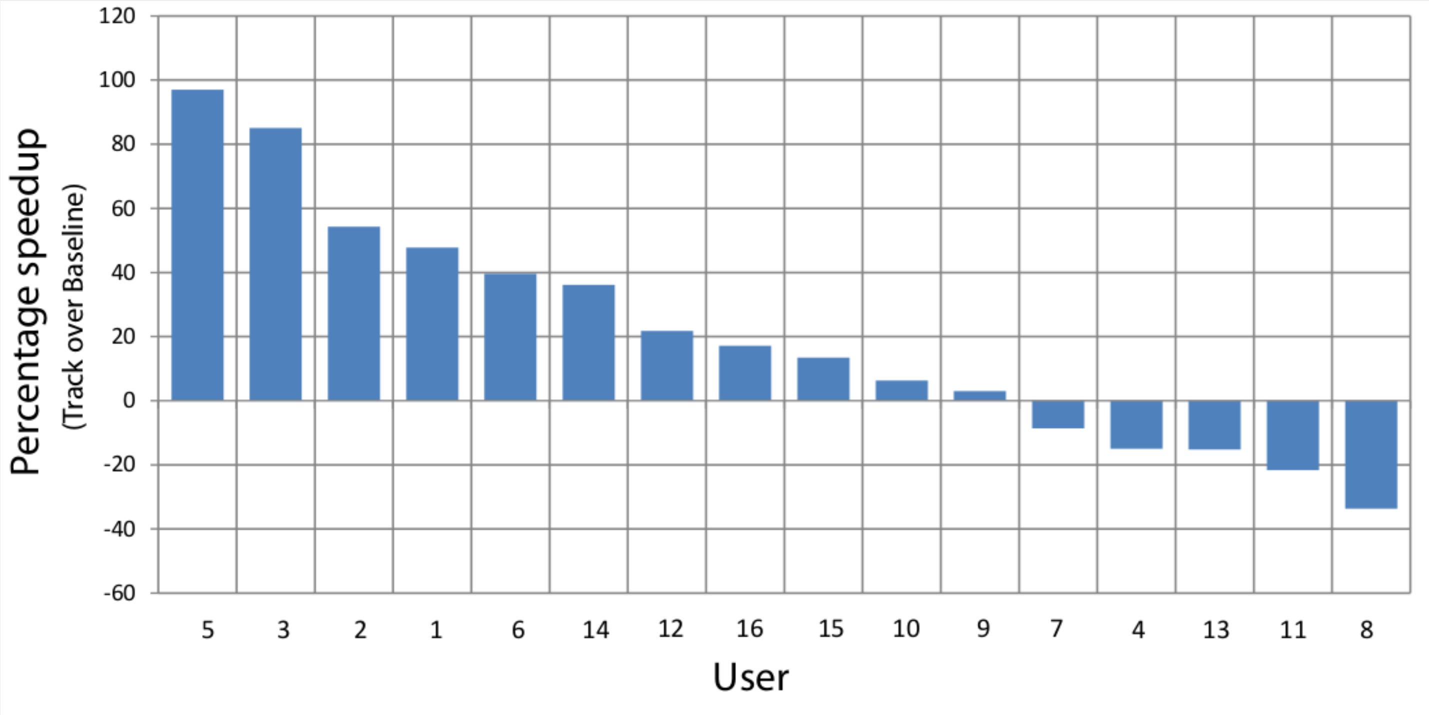
(a) Model A (b) Model B (c) Model 1 (d) Model 2 (e) Model 3
(f) Model 4 (g) Model 5 (h) Model 6 (i) Model 7 (j) Model 8

Results, one block

- 21.8 seconds for Baseline
- 18.9 seconds for Track
- 14% of improvement
- 3 mistakes with Baseline
- 0 with Track

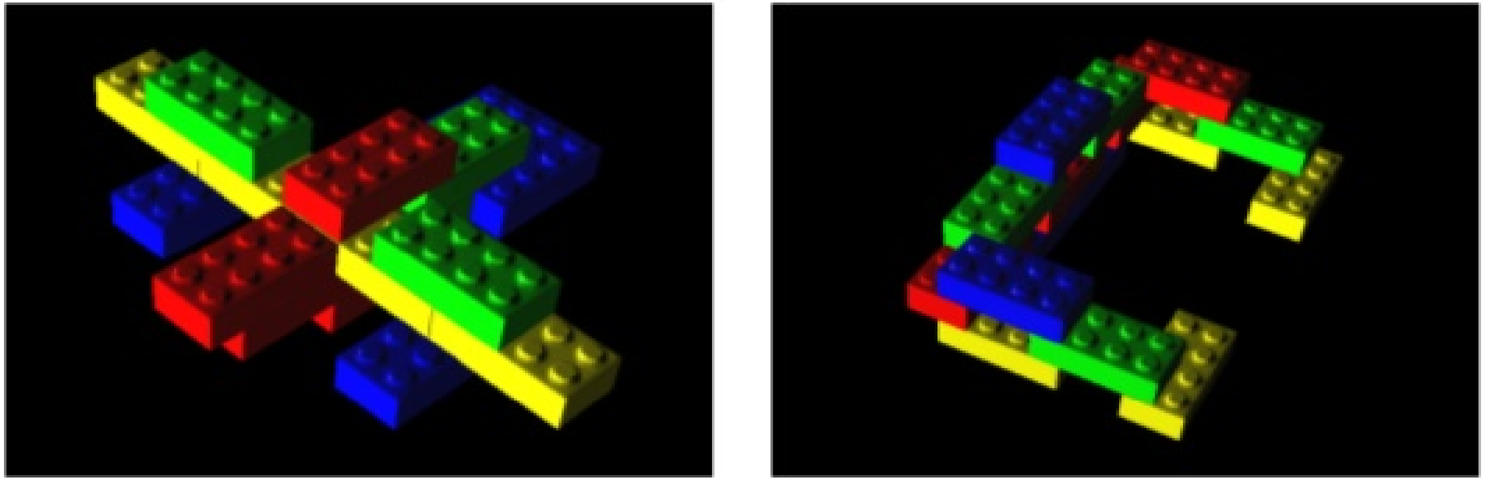
Results, one block

$$speedup = 100 * \left(\frac{Time(Baseline)}{Time(Track)} - 1\right)$$



Results, multiple blocks

Times to add blocks one after the other



(a) Model A. (b) Model B.

Results, multiple blocks

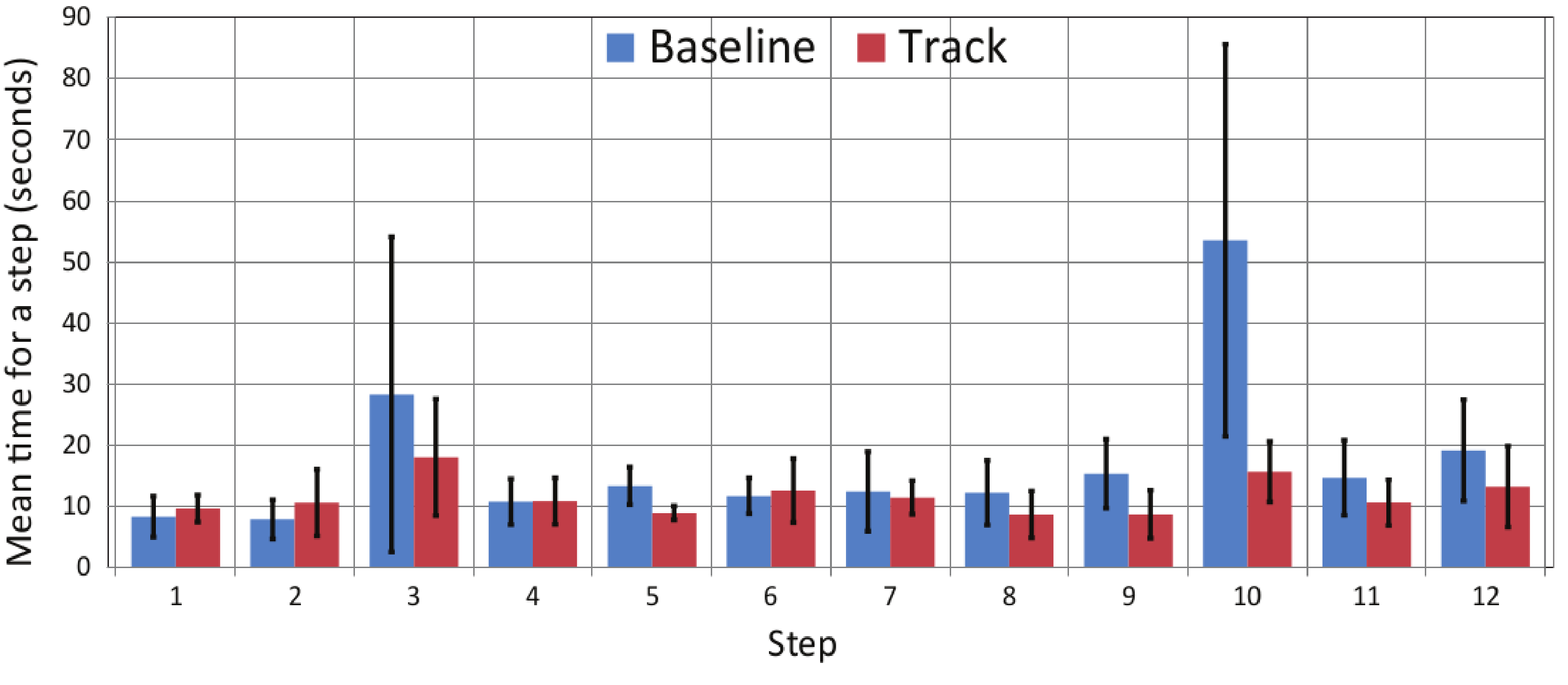
- Model A
- 11.6s Track
- 17.3s Baseline
- 7 mistakes Baseline
- 0 mistakes Track

Introduction

Real-time Modeling and Tracking Manual Workflows from First-Person Vision

DuploTrack: A Real-time System for Authoring and Guiding Duplo Block Assembly

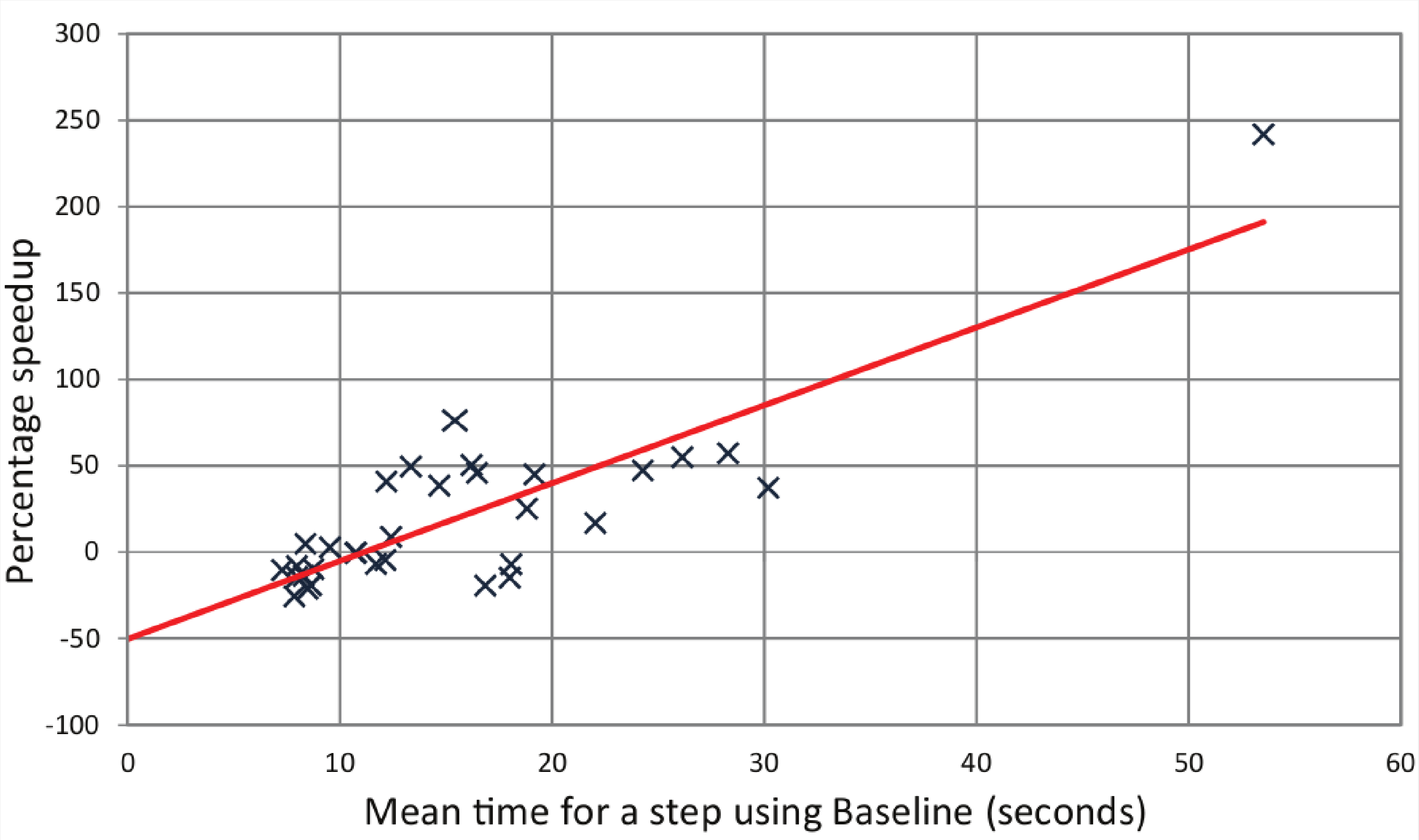
Results, multiple blocks



Results, multiple blocks

- Model B
- 10.03s for Track
- 10.22s for Baseline
- 0 mistakes for both interfaces

Results, multiple blocks



Results, qualitative feedback

- 11 of 16 participants preferred Track
- 3 participants preferred Baseline
- All said Track was more enjoyable

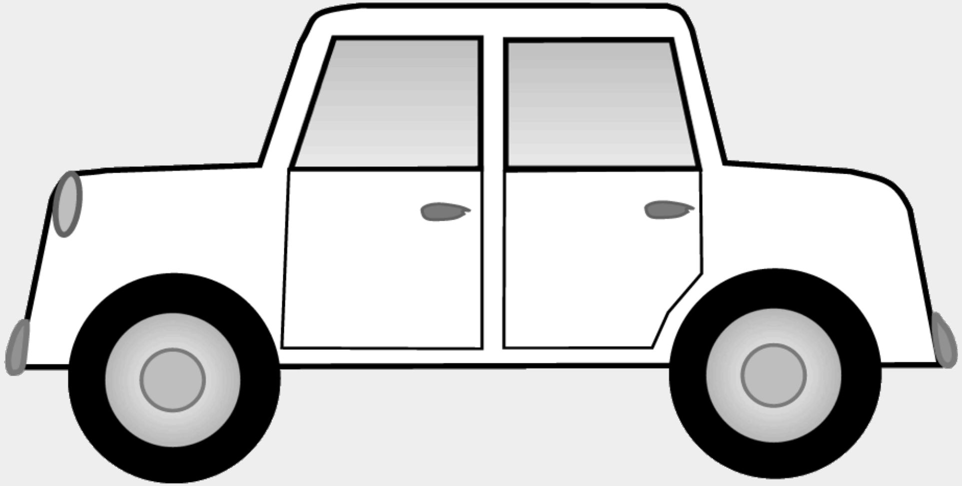
Results summary

- Track increased on average the speed and accuracy
- For some participants negative speedup
- For more complicated models the results may be even better

Future work

- Extend system to handle smaller blocks
- Different shapes
- Furniture assembly
- Home repairs

Situation Awareness for Proactive In-Car Recommendations of Points-Of-Interest



- Recommendation system for in-car context
- Fuel stations, restaurants, parking lots

[3]

Driver's attention

Proactive system

User above the interaction loop

Resource: Driver's attention

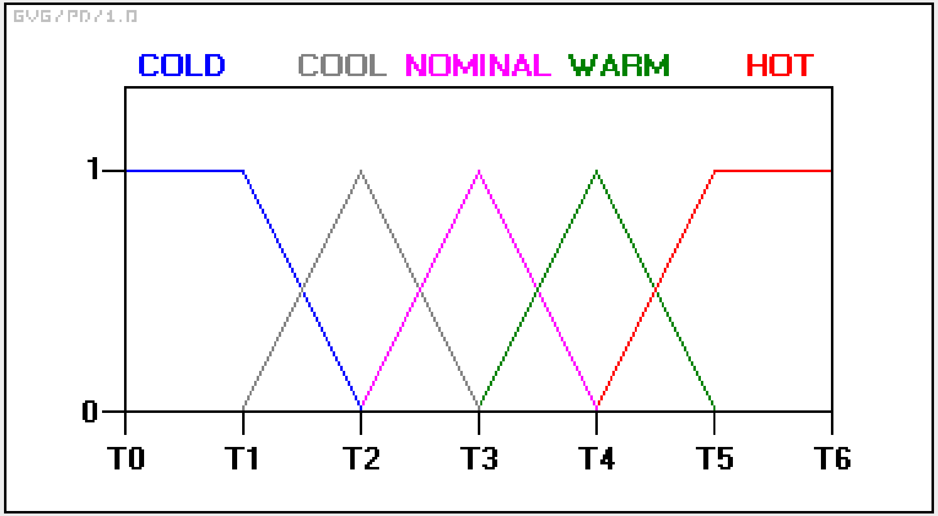
Focus: Relevance of information - The right information at the right time to the right user

Three levels of situation awareness

- Level 1 context sensing
- Level 2 situation comprehension
- Level 3 projection into the future

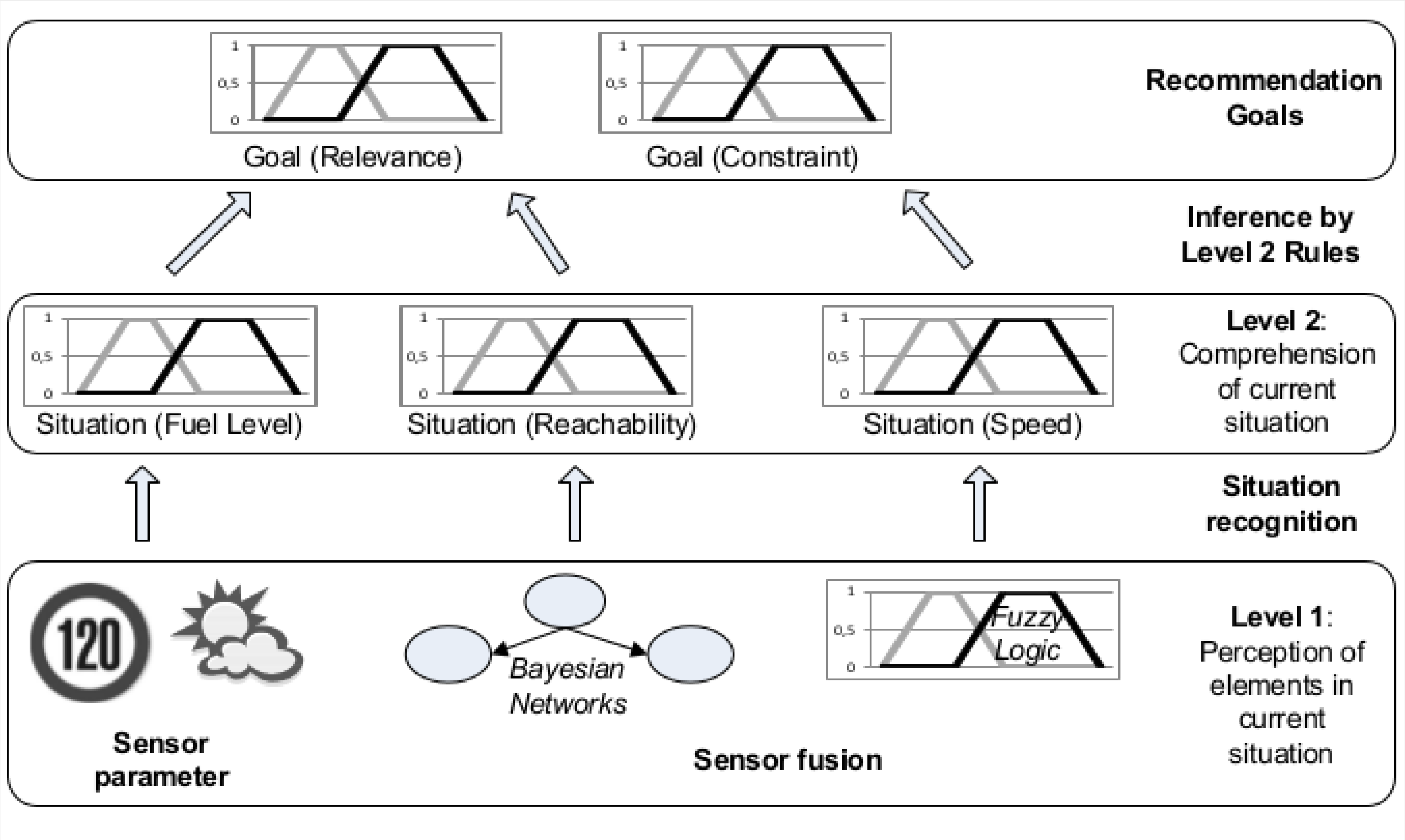
Model for Situation Awareness in Proactive Systems

- Fuzzy logic values between 0..1
  - Certainty expression
  - No abrupt behavior



[7], [20]

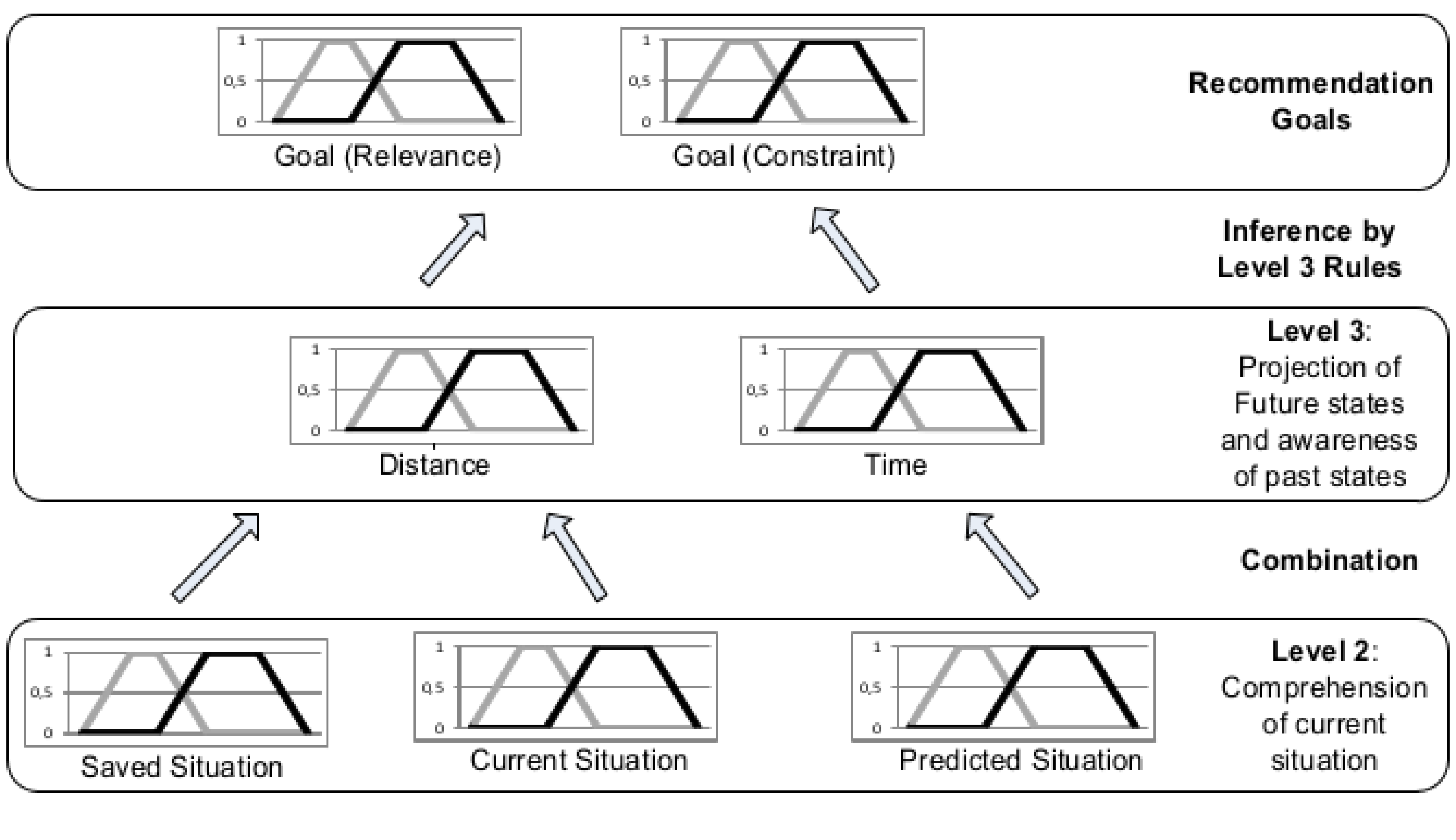
Model for Situation Awareness in Proactive Systems



Model for Situation Awareness in Proactive Systems

IF fuel_level == empty THEN relevance_fueling = high

Model for Situation Awareness in Proactive Systems



Model for Situation Awareness in Proactive Systems

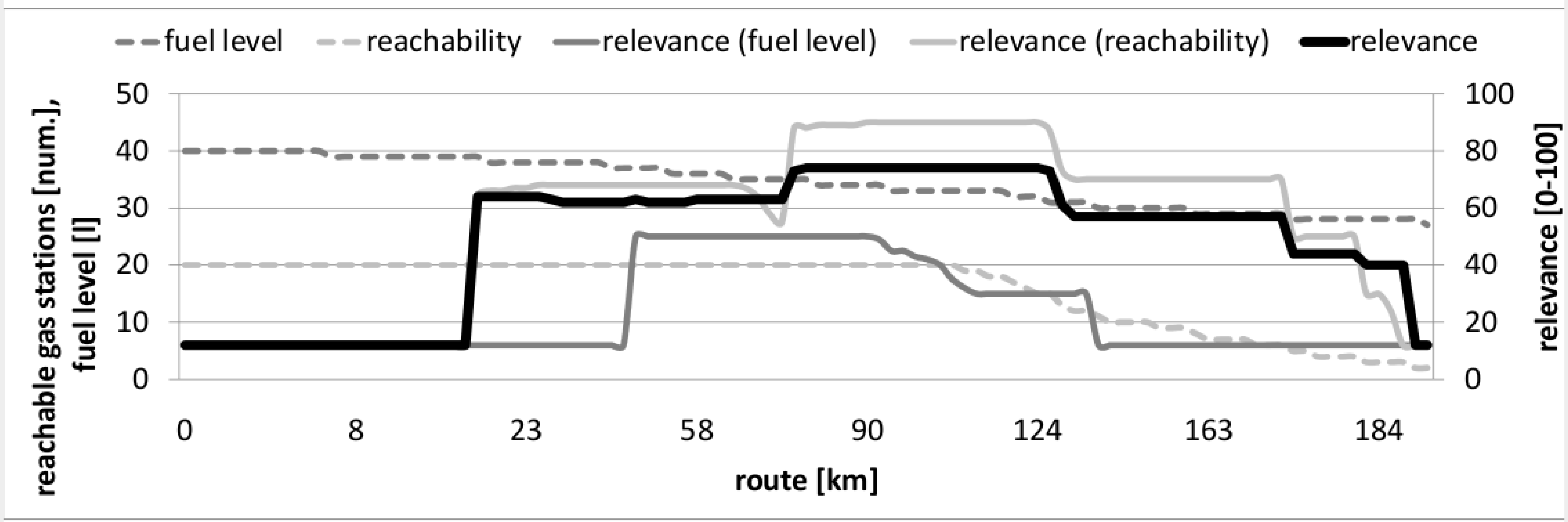
IF fuel_level == empty AND distance == close

THEN relevance_fueling = high

Evaluation

- Fuel level and station reachability
- Connection fuzzy variable
- Low fuel stations coverage area
- 40 liters gas, 20 reachable stations
- 800km

Evaluation



fuel level
reachability
relevance (fuel level)
relevance (reachability)
relevance
reachable gas stations [num.], fuel level [l]
50
40
30
20
10
0
100
80
60
40
20
0
relevance [0-100]
0
8
23
58
90
124
163
184
route [km]

Future work

- More complex scenarios
- User study
- Comparison to other models

Summary

- Assistant

  Helps with some task, trust issues

- Intelligent assistant

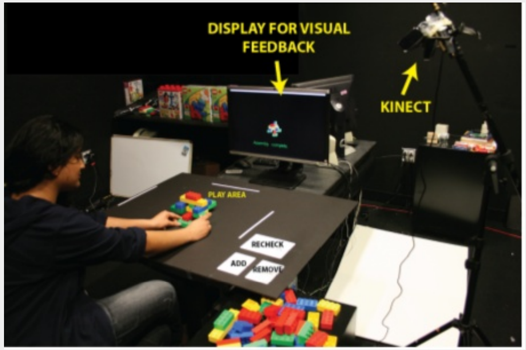
  Privacy issues

- Context

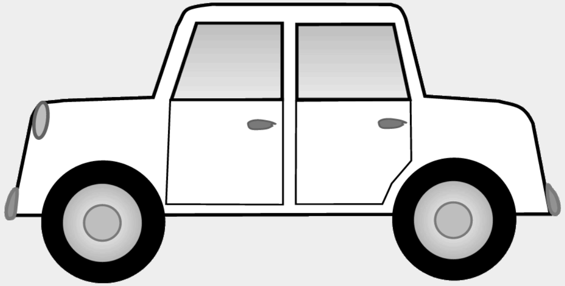
  Characterize a situation

Summary

Tracking of manual workflows



Guiding Block Assembly



Situation Awareness for In-Car Recommendations

Guiding systems

Recommender system

References

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- [8] Overview of the RANSAC Algorithm http://www.cse.yorku.ca/~kosta/CompVis_Notes/ransac.pdf (12.05.2015)
- [9] How private is Amazon Echo? http://www.slashgear.com/how-private-is-amazon-echo-07354486/ (12.05.2015)

Images:

- [13] 8 hilarious IKEA memes, http://blog.ted.com/8-ikea-memes-and-homages/, (12.05.2015)
- [14] Siri-Chan: http://ikiwed.deviantart.com/art/Siri-Siri-chan-266625034 (12.05.2015)
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- [18] Smartphone: http://pixabay.com/static/uploads/photo/2013/07/12/18/39/smartphone-153650_640.png (12.05.2015)

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