

- Learning and adaptation
- Interfaces
- Control
- Applications
- Physical design / appearance
- Evaluation metrics
- Safety
- Levels of autonomy
- Social Interaction/psychology
- Ethics
- Trust and deception
- Perception of robots by humans
- Exhibiting and recognizing emotions
- Multimodal interactions
- Constraints on robot abilities
- Cultural considerations
- Communication
- Legal implications
- Levels of cognition
- Human-robot teamwork
- Impact on human society

**Research**

**Novelty Tech**

**Pervasive Tools**

Personal  
Computing



ENIAC



Apple II



Laptop



OLPC

**Research**

**Novelty Tech**

**Pervasive Tools**

**Personal Computing**



**ENIAC**



**Apple II**



**Laptop**



**OLPC**

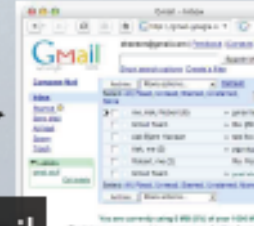
**Internet**



**ARPANet**



**Mosaic**



**Gmail**



**YouTube**

Research

Novelty Tech

Pervasive Tools

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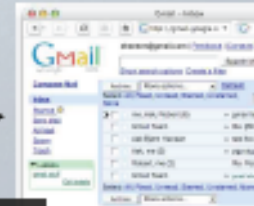
Internet



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Sketchpad



Tron



Final Fantasy



Madden

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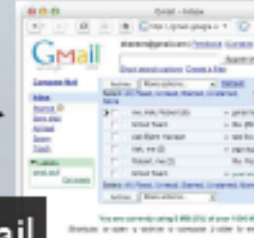
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Tron



Final Fantasy

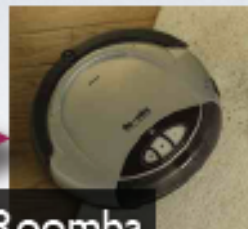


Madden

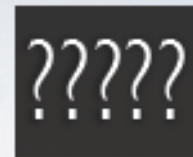
Robotics



Shakey



Roomba



# Timeline of HRI

1941 – Asimov's *I, Robot*

....

1992 - IEEE International Symposium on Robot and Human Interaction Communication

2006 – HRI conference

2009 – International Journal of Social Robotics

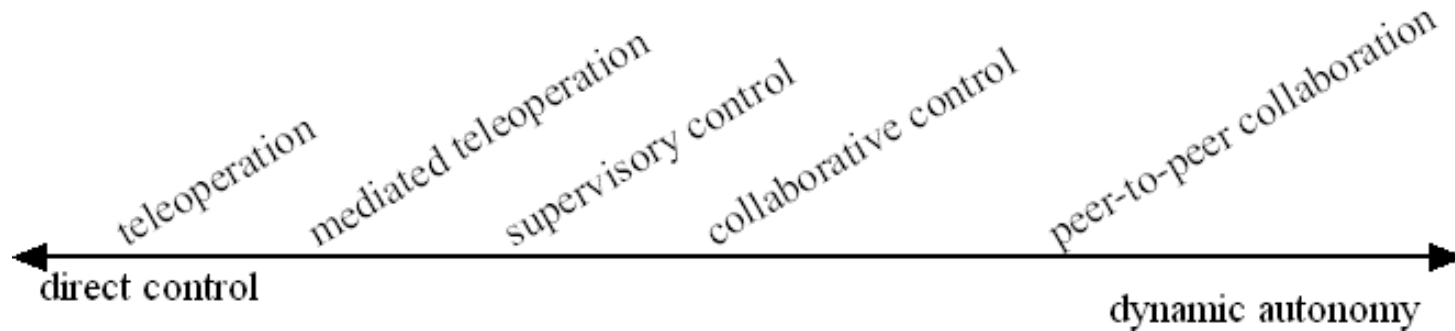
2011 – Pres. Obama launches National Robotics Initiative

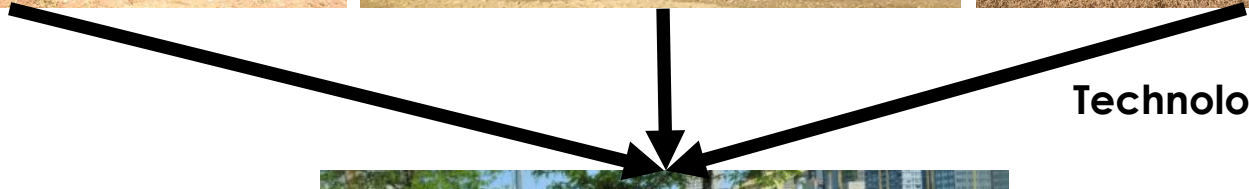
2012 – Journal of Human Robot Interaction



# Why the increasing importance of HRI?

Many reasons... but ultimately because *all* robots have some dependency on humans.





Technology Pipeline



← HRI becomes critical



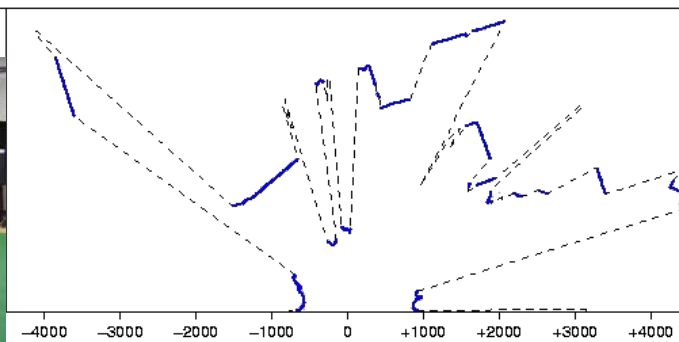
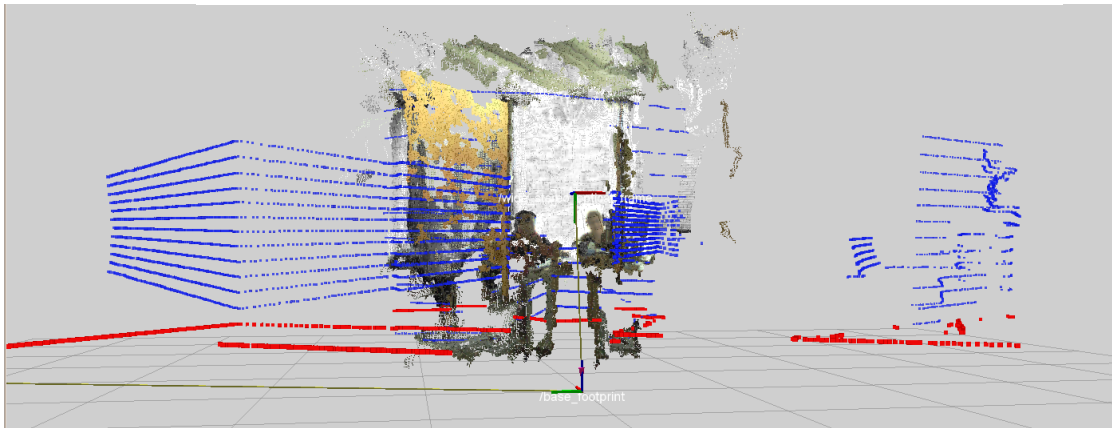
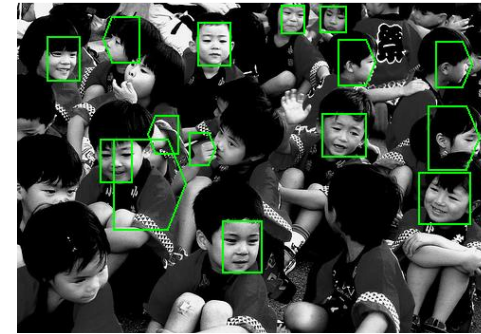
What does society want to  
do with robots?

# 2 Case Studies

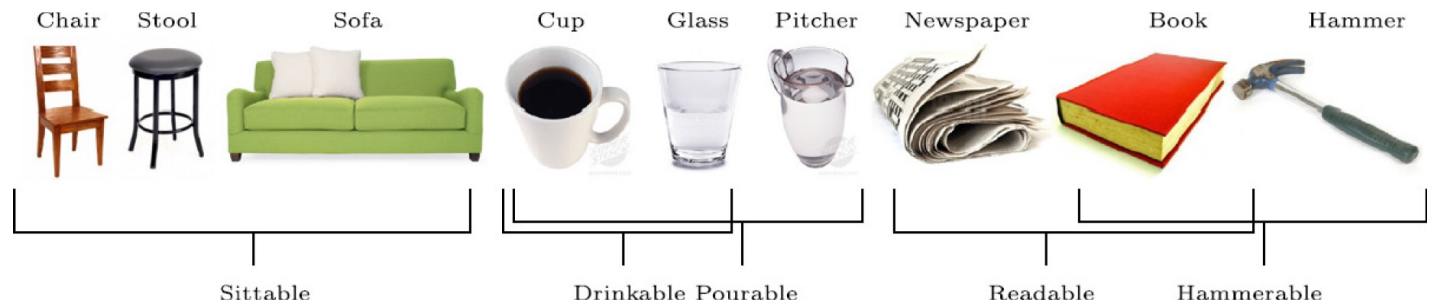
- [Autonomous City Explorer \(ACE\)](#)
- Home Exploring Robotic Butler (HERB)

# What perceptual capabilities does an interactive robot need?

- Person detection
- Object recognition
- Scene recognition
- Face recognition
- Speech recognition
- Gesture recognition
- Intonation recognition
- Posture and proximity recognition
- Emotion recognition
- ...smell?
- ...



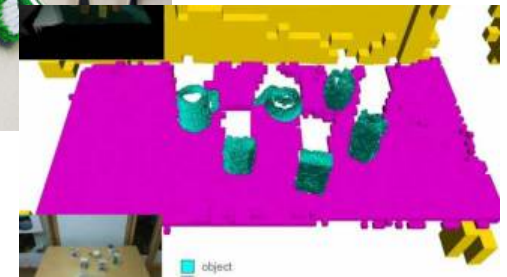
# Object Affordances



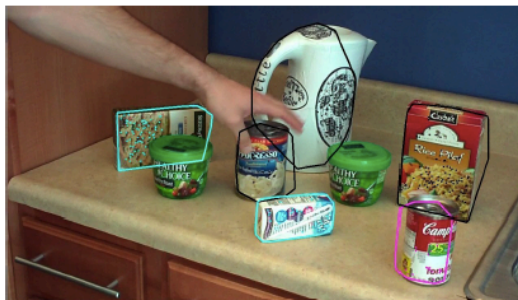
# Robot sensing...



This is where we want to be...



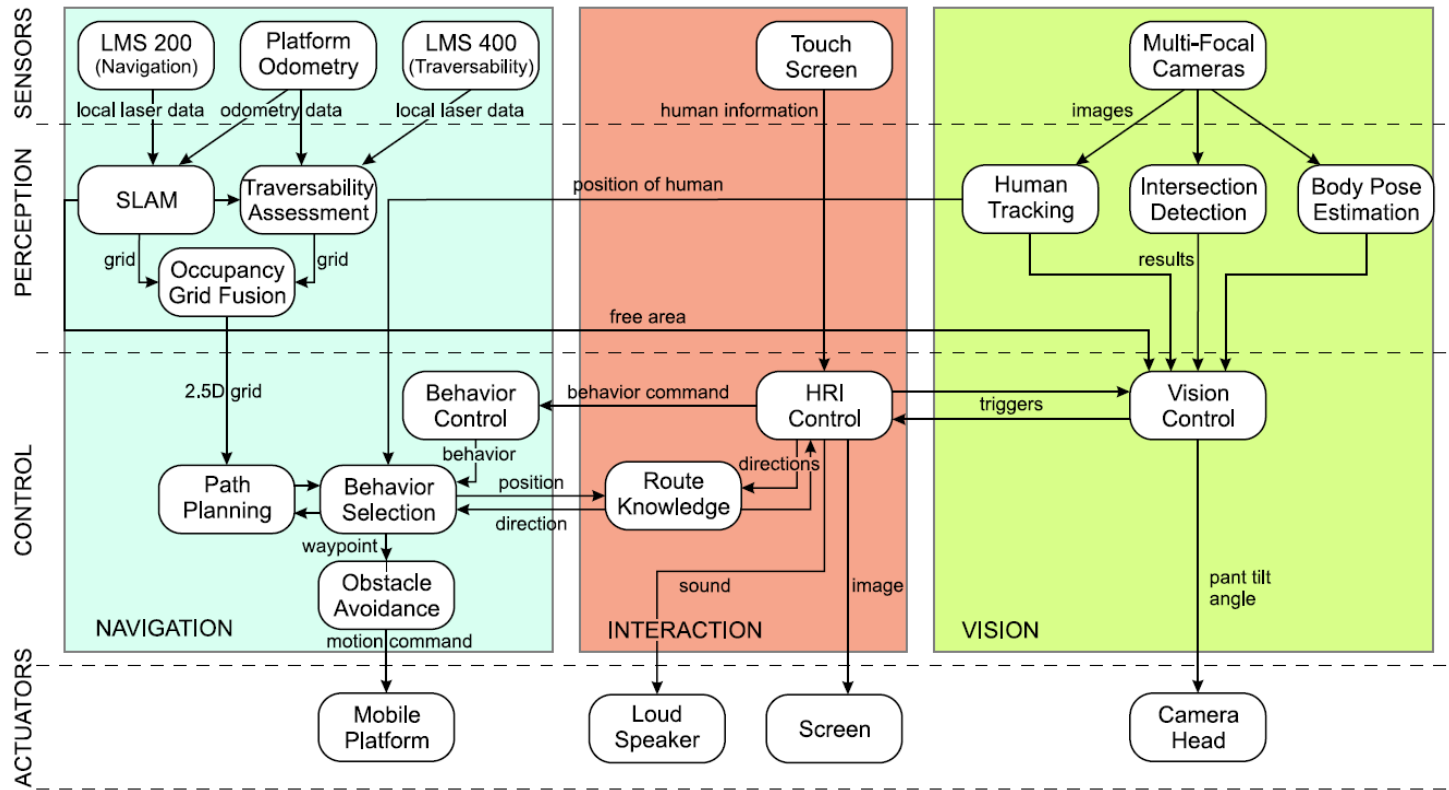
This is where we are...



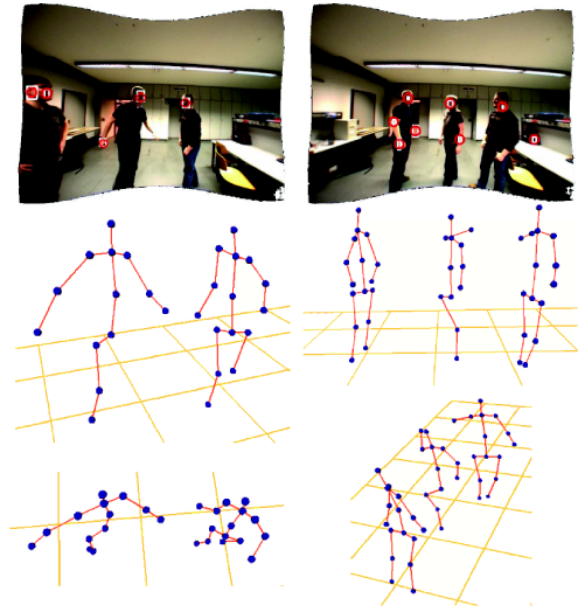
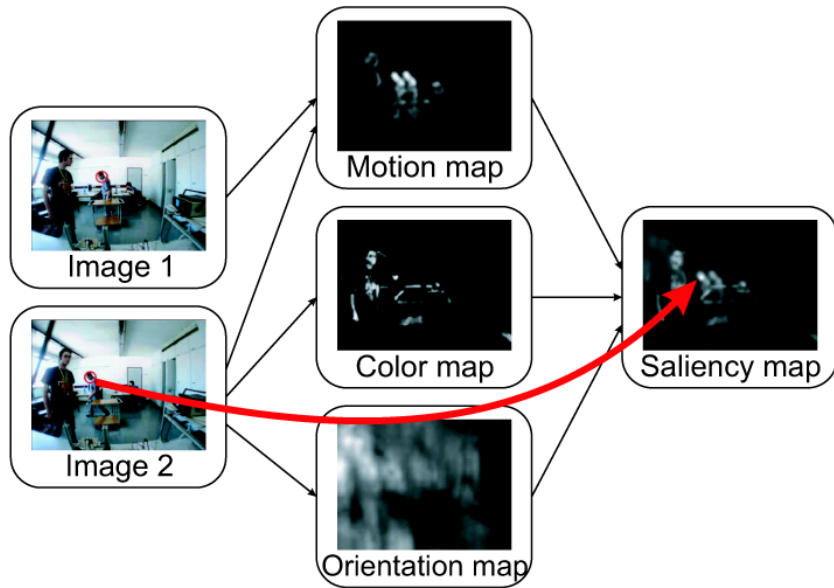
# Autonomous City Explorer



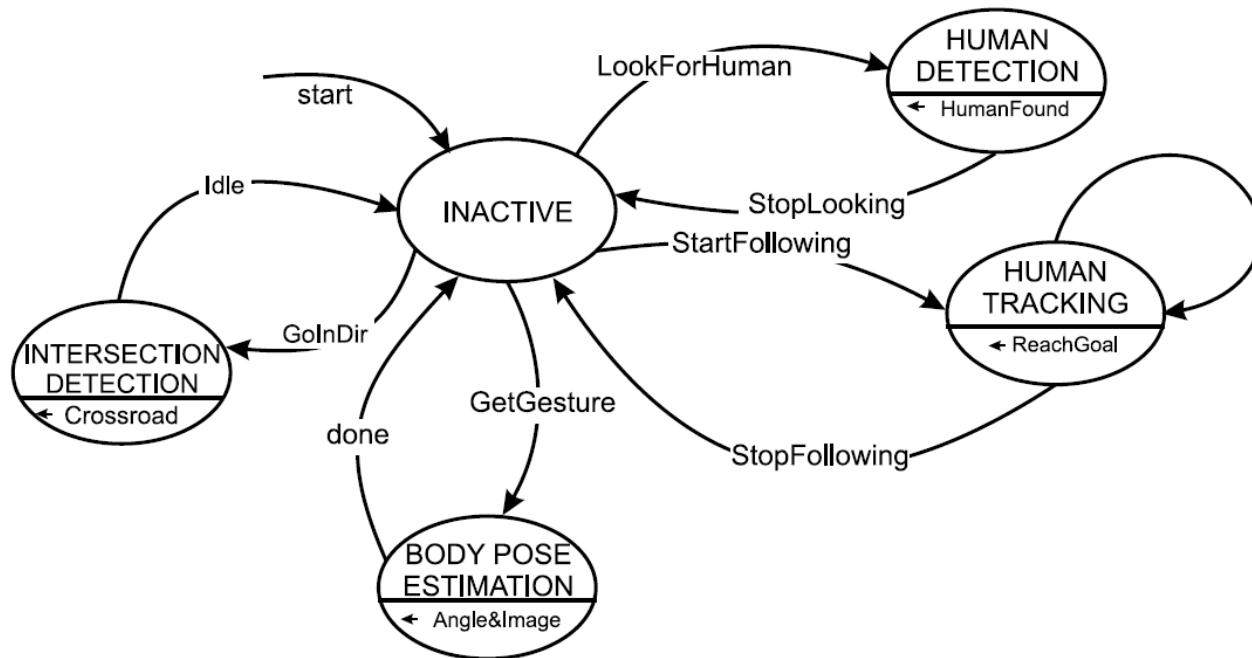
Next generation of ACE



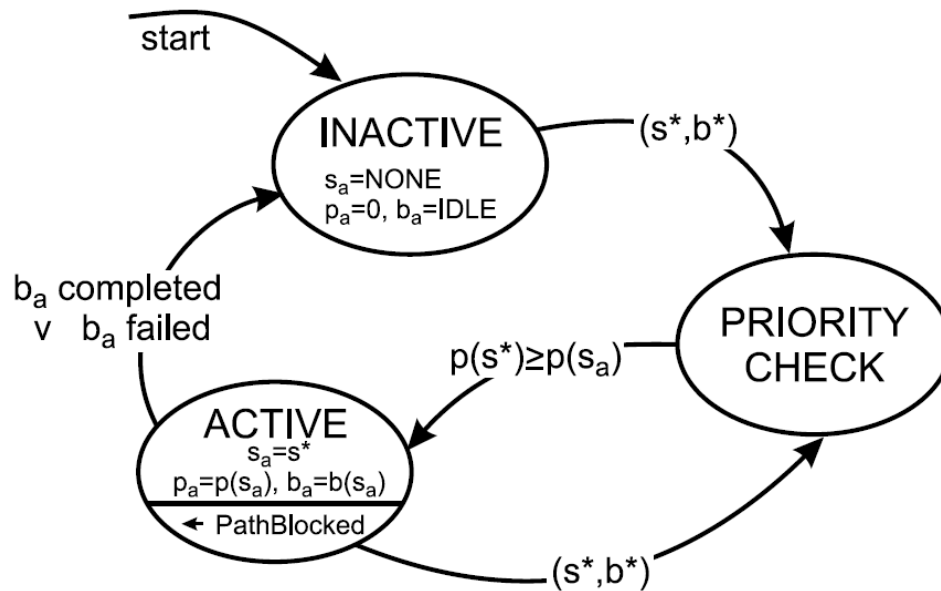




# FSM for Vision Subsystem

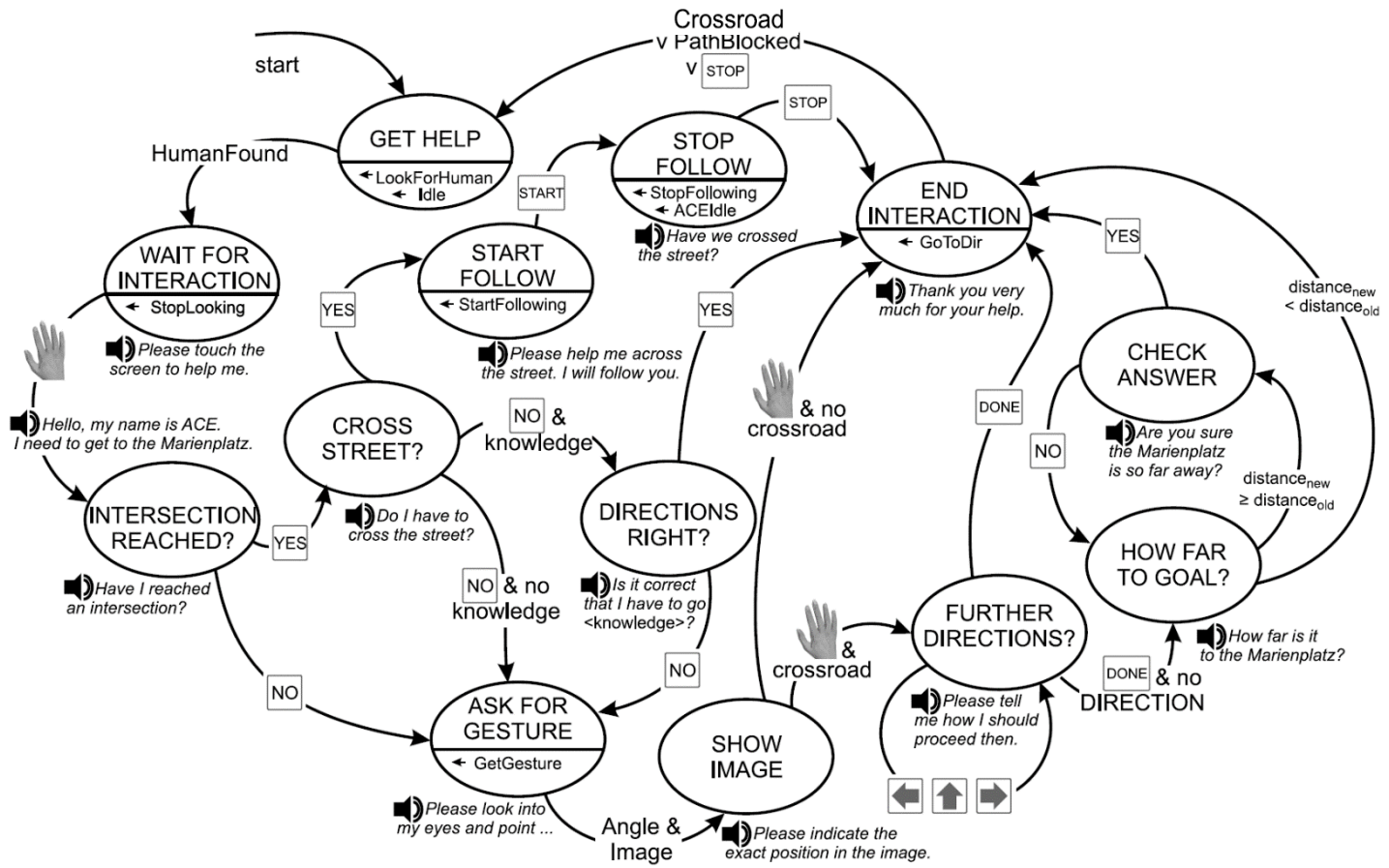


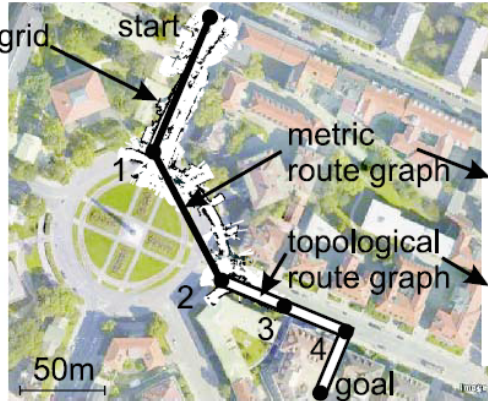
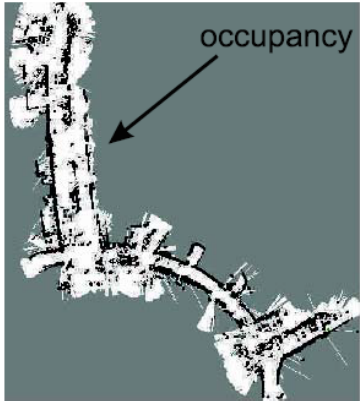
# Behavior Control



s = subsystem  
p = priority  
b = behavior

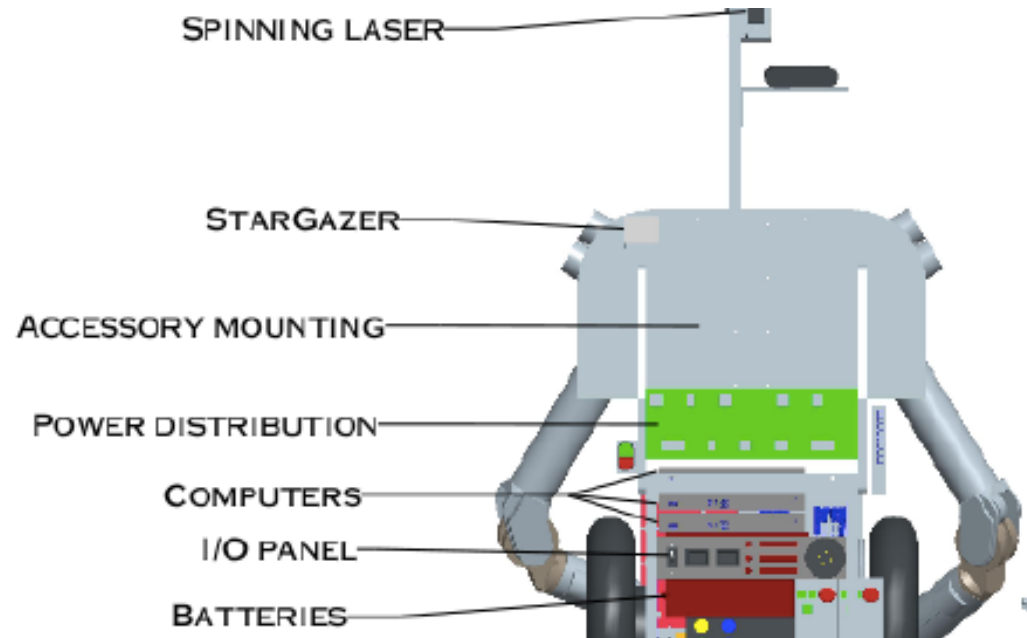
\* new trigger  
\_a active



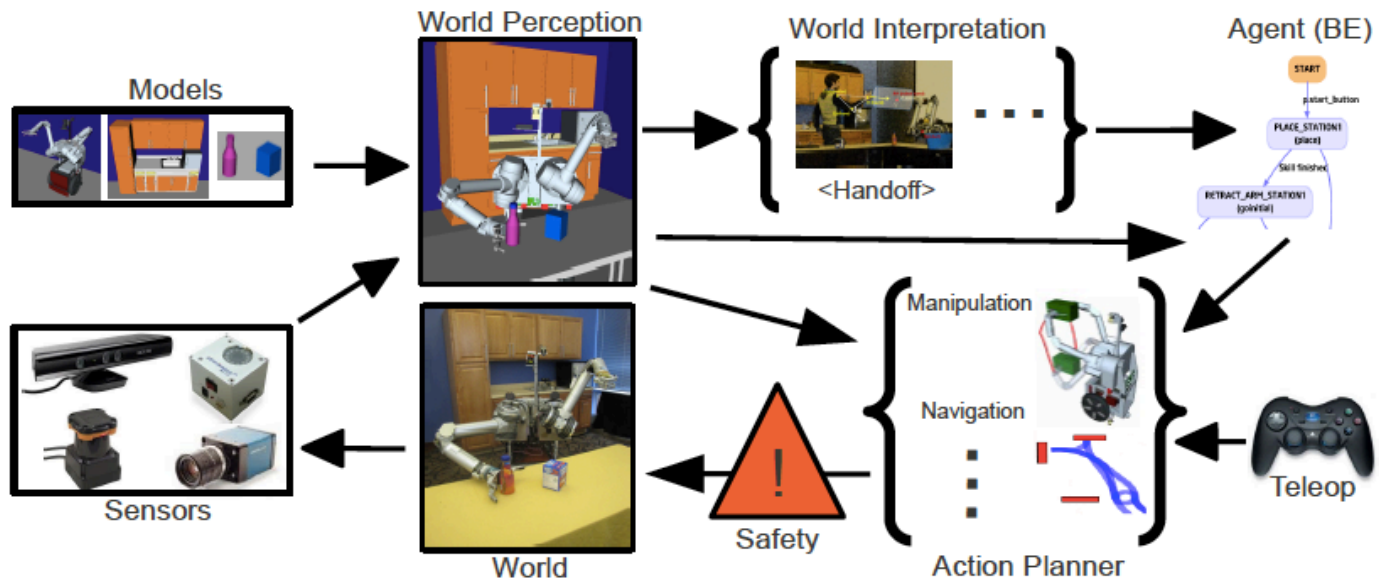


nodes:	edges:
$N_s ( 0, 0, 1)$	$E_s^1 (N_s, N_1)$
$N_1 ( 86, -1, 1)$	$E_1^2 (N_1, N_2)$
$N_2 ( 61, 58, 1)$	$E_2^3 (N_2, N_3)$
$N_3 (0.7, 0.7, .5)$	$E_3^4 (N_3, N_4)$
$N_4 ( 1, 0, .5)$	$E_4^g (N_4, N_g)$
$N_g ( 0, -1, .5)$	

# HERB



# System Architecture



Take a note card and summarize any observations, contrasts, questions or comments you have regarding the papers. Brief statements/bullet points are fine.



As a group:

1. Briefly analyze both the ACE and HERB platform within the HRI Taxonomy
2. Note the differences in the designs of these systems at the hardware, sensor or architecture level
3. Identify the source of each difference (e.g., application-driven, cost-driven, unknown...)
4. What scientific impact does each robot make?
5. What are the most significant limitations of each platform, for its given application?