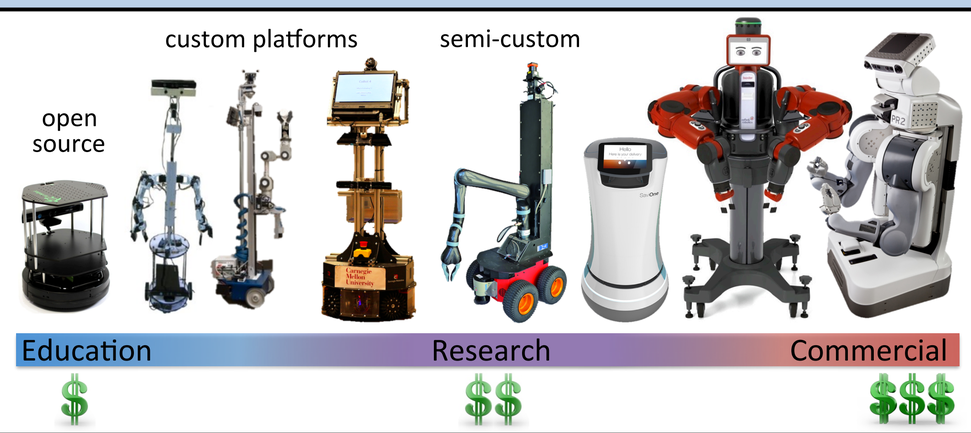
Design of a Low-Cost Platform for Autonomous Mobile Service Robots

Eric Eaton, Caio Mucchiani, Mayumi Mohan,
David Isele, Christopher Clingerman, José Marcio Luna
University of Pennsylvania

Motivation

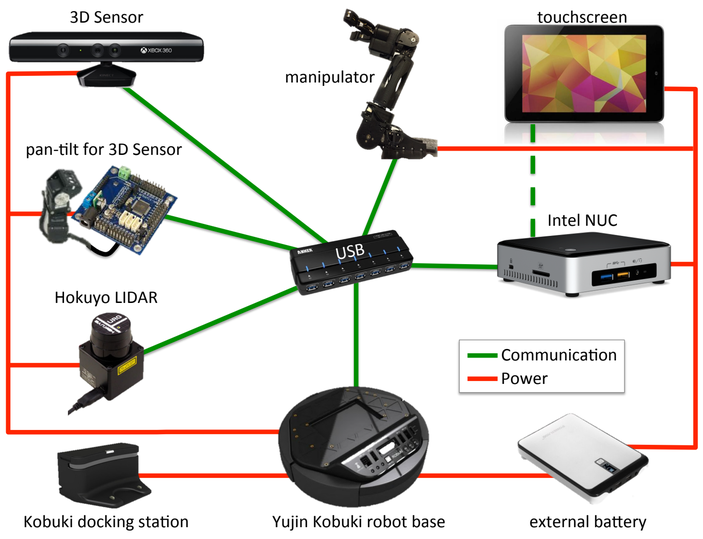
Most current autonomous mobile service robots are either expensive commercial platforms or custom-manufactured for research environments, limiting their availability. Current low-cost platforms provide little capability.

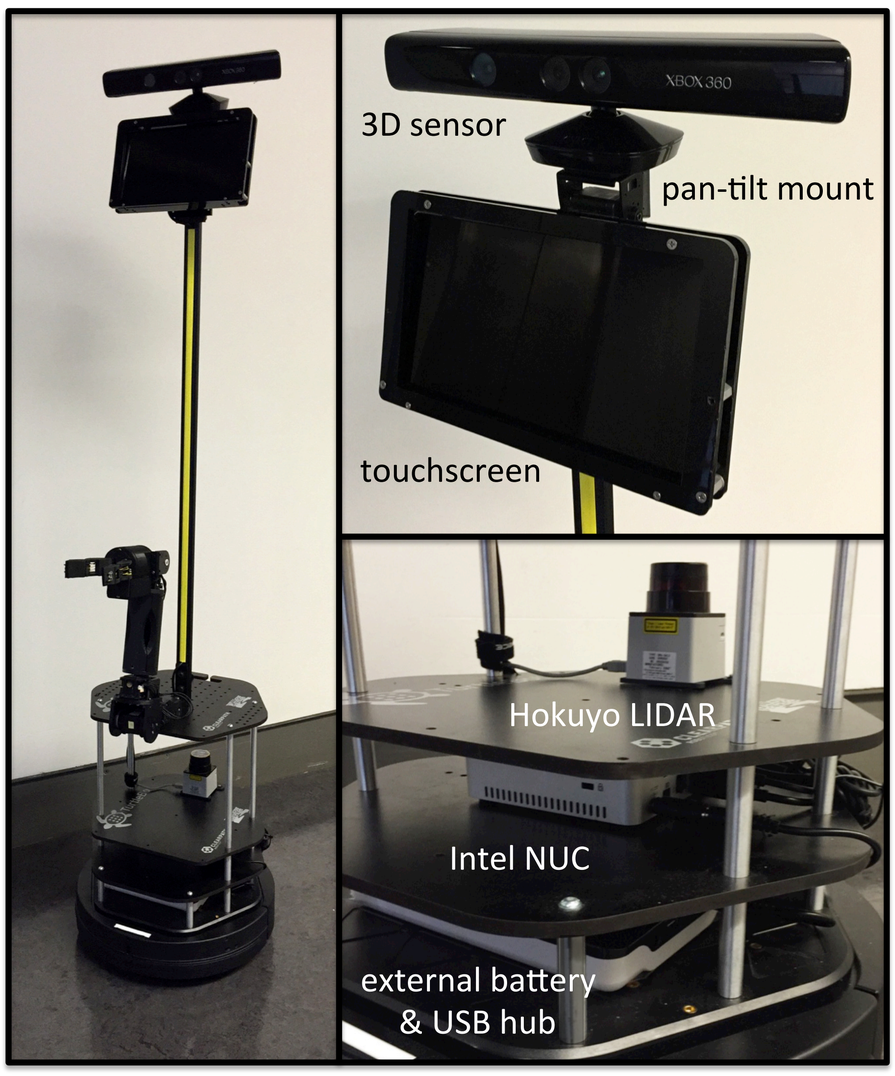
Goal: Design a low-cost, easily creatable, open source service robot platform



Low-Cost Service Robot Platform

- Based on TurtleBot 2 to ease adoption
- Easily constructed from COTS and 3D-fabricated parts
- Designed to handle a variety of indoor service tasks: deliver/retrieve objects, telepresence, tour guide, information, etc.





Shoulder-height touchscreen

- Nexus 7 (or other) tablet
- Interaction/telepresence
- Extruded aluminum mast

Enhanced computation

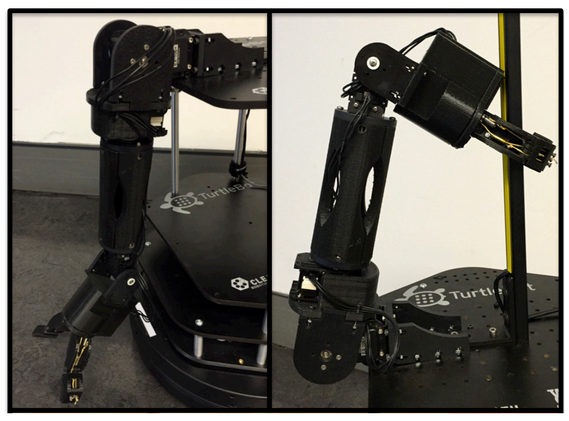
- Intel NUC core i5 or i7
- COTS external battery
- Approx. 6 hours of runtime

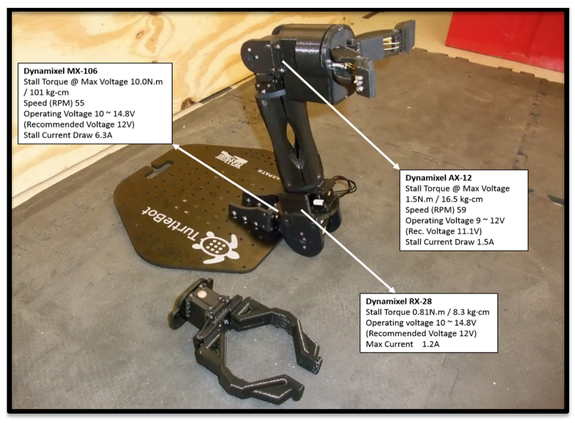
Improved perception

- Hokuyo LIDAR
- Top-mounted 3D camera on optional pan/tilt mount

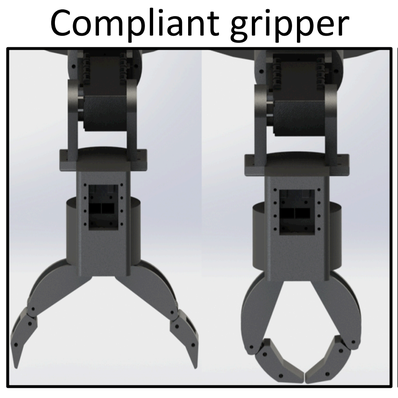
Modular Robotic Arm

- 3D-printed PLA, laser-cut ABS
- Dynamixel servos
- Modular gripper
- Arduino controller / ROS

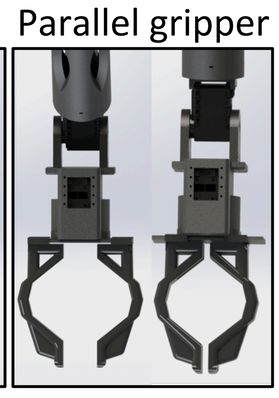




Compliant gripper



Parallel gripper



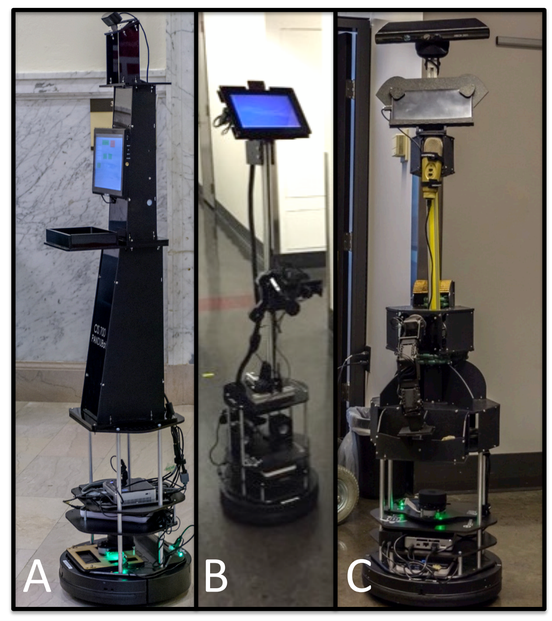
	PhantomX Reactor	DesiArm	WidowX Mark II	[Quigley et al.]	Dr. Robot Jaguar	Cyton Gamma 1500	Universal Robots UR3	KUKA Youbot
Estimated Cost	$550	$850	$1,500	$4,135	$8,750	$12,000	$23,000	$24,200
Degrees of Freedom	6	4	6	7	4	7	6	5
Total weight (Kg)	1.36	0.75	1.33	11.4	10	2	11	7.4
Max Payload (Kg)	0.6	1.4	0.8	2	4	1.5	3	0.5

Estimated Cost

Item	Estimated Cost
TurtleBot 2 Robot & Accessories	$1,350 USD
Onboard Computer	$750 USD
Mast & Touchscreen	$350 USD
LIDAR, Speakers, Microphone	$1,150 USD
DesiArm	$850 USD
Total	$4,450 USD

Variations on the Platform

- Developed by students in CIS 700 at Penn in Fall 2015
- Robots B & C include an elevator for the arm
- Example projects:
  - waiting tables at a simulated restaurant
  - object search and retrieval
  - voice-based navigation



For More Information

http://www.seas.upenn.edu/~eeaton/projects/servicerobot/