

# Calliope

An Open Source Platform  
For Low-Cost Navigation  
and Manipulation



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# Start With Commodity Components

iRobot Create (\$250)  
ASUS Netbook (\$225-300)  
Logitech webcam (\$70)

▶ Low-cost because they're mass produced

▶ Durable

▶ Wheels are simpler (and cheaper) than legs





# Add A Pan/Tilt camera

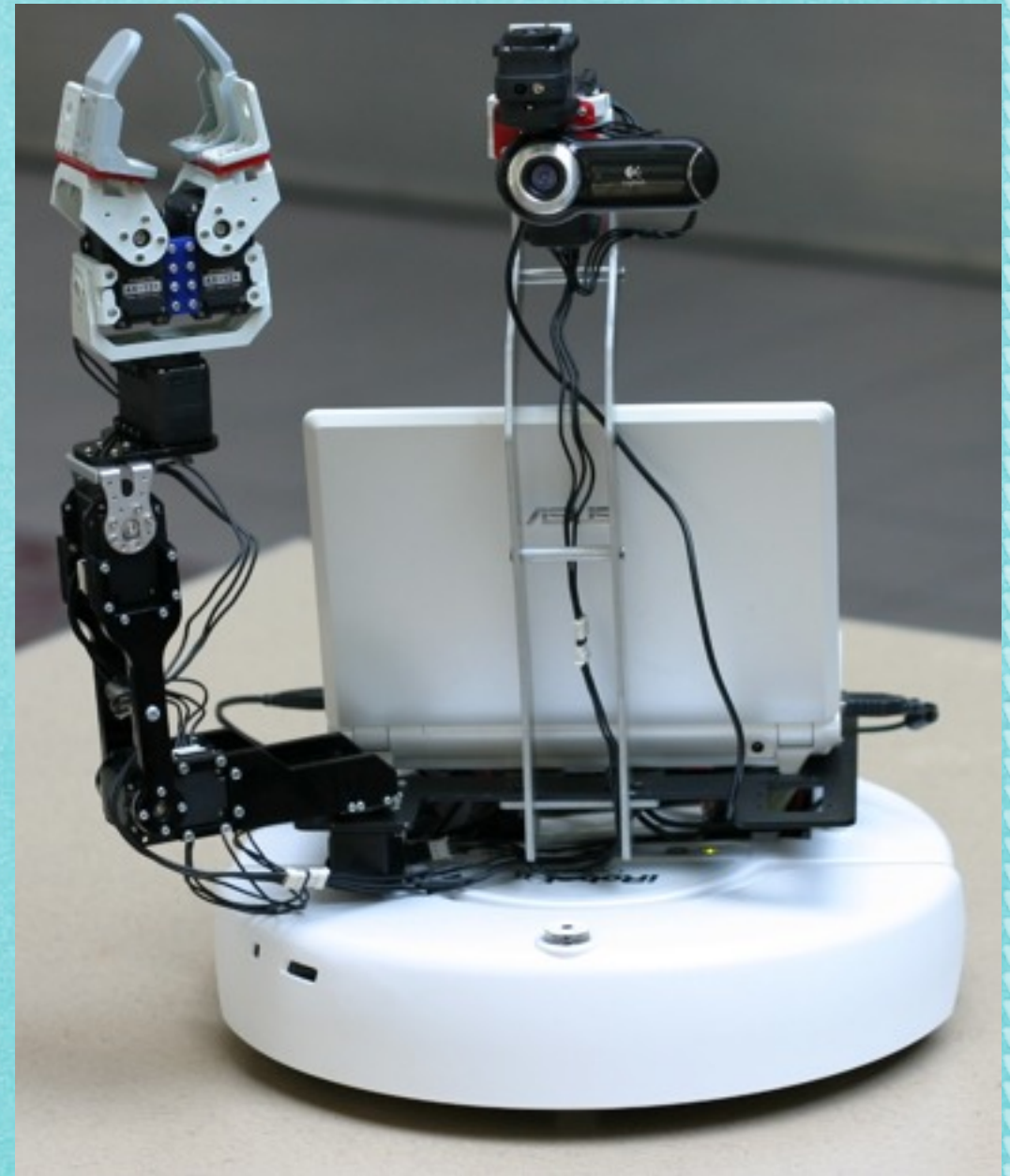
- ▶ Webcam field of view  $\sim 60^\circ$
- ▶ Pan/Tilt lets the robot look around without moving its body
- ▶ Applications:
  - ▶ Visual Search
  - ▶ Landmark tracking during navigation
  - ▶ Moving target tracking





# Add Arm and Gripper

- ▶ Base yaw, shoulder and elevator pitch, wrist roll, fingers open/close
- ▶ Teach kinematics and manipulation
- ▶ Greatly increase the tasks the robot can perform
- ▶ Design still being refined





# We Use Robotis Servos

- ▶ Two AX-12s for pan/tilt (\$45 each)
- ▶ RX-24F (\$140) and two RX-28s (\$210 each) for the upper arm
- ▶ AX-18F (\$95) and two AX-12s for gripper
- ▶ AX-S1 sensor module (\$45)
- ▶ USB2Dynamixel interface (2 x \$50)
- ▶ Misc hardware (brackets, screws, cables)
- ▶ Separate battery (12V 5000 mAH NiMH)

Total price  
under \$2,500





# Support & Availability

- ▶ Tekkotsu support from CMU and FAMU
- ▶ Player/Stage support from Univ. of Alabama
- ▶ Plans and parts list will be available at [Chiara-Robot.org/Calliope](http://Chiara-Robot.org/Calliope)
- ▶ Fully-assembled versions will be available from RoPro Design, Beaver, PA



# Work Remaining

- ▶ Develop a kinematics solver for the final arm configuration.
- ▶ Extend Tekkotsu's existing 2D RRT path planner to handle 3D arm path planning.
- ▶ Develop high level primitives (e.g., “pick up that object”) for the arm, to be implemented as part of Tekkotsu's Grasper component.
- ▶ Finish Player/Stage and ROS support.
- ▶ Document everything so you can built your own!