

# *From Create to Calliope: Progress on a New Standard Platform for ARTSI*

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# *The Create/ASUS Robot*

- iRobot Create base (plus battery, charger)
- ASUS 900 Eee PC netbook; Easy Peasy Linux
- Custom mounting bracket; USB cable
  
- Parts cost: around \$600
- Approx. 40 built for ARTSI
- RoPro Design retails for \$785
- <http://Chiara-Robot.org/Create>



# *Why Is This Robot So Cheap?*

- The main components are mass-produced consumer electronics:
  - iRobot has sold over 5 million Roombas
  - ASUS is a major vendor of netbooks
  - Both companies manufacture in China
- The remaining components (USB cable, ABS plastic mounting bracket) are trivial.

# *So What More Could You Want In A Low-Cost Robot?*

- Separate camera on a pan/tilt mount.
- An arm with gripper.

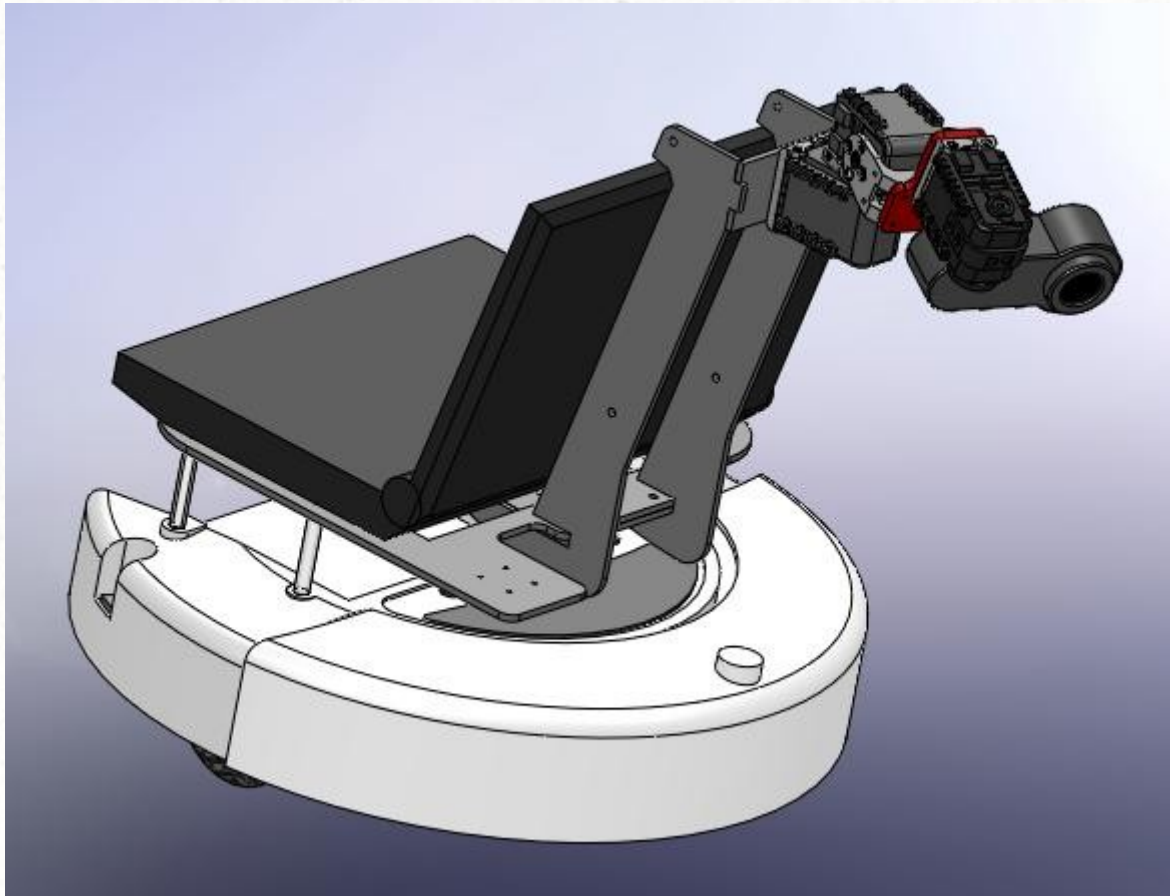
# *Pan/Tilt Camera*

- Webcams have a narrow 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
  - Perhaps even face tracking

# *Pan/Tilt Implementation*

- Robotis Dynamixel AX-12 servos for pan, tilt (similar to the Chiara)
- USB2Dynamixel interface board
- Logitech Pro 9000 webcam
- Bonus: AX-S1 sensor module with 3-way IR rangefinders, sound detector, and other features
- Acrylic mounting plate for webcam and AX-S1
- Separate battery to power the servos

# *Conceptual Sketch*



## *But What Will It Cost?*

- No longer just mass-produced consumer stuff.
  - AX-12 servos \$45 each 90
  - AX-S1 sensor module 60
  - USB2Dynamixel 60
  - Logitech webcam 90
  - NiMH 12V battery 60
  - Mounting bracket 25 (?)
- Total: \$385. That's more than the netbook!

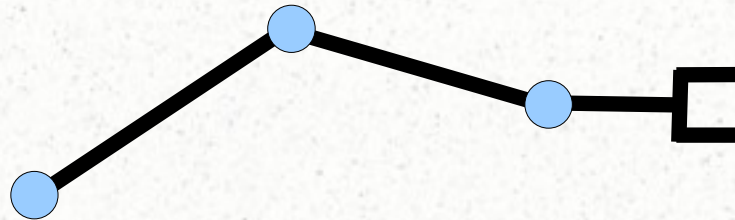


## *Demo: Landmark Tracking*

- Detect bicolor markers.
- Move pan and tilt joints to keep the marker centered in the camera image.
- Use the RawCam viewer to see what the robot sees.

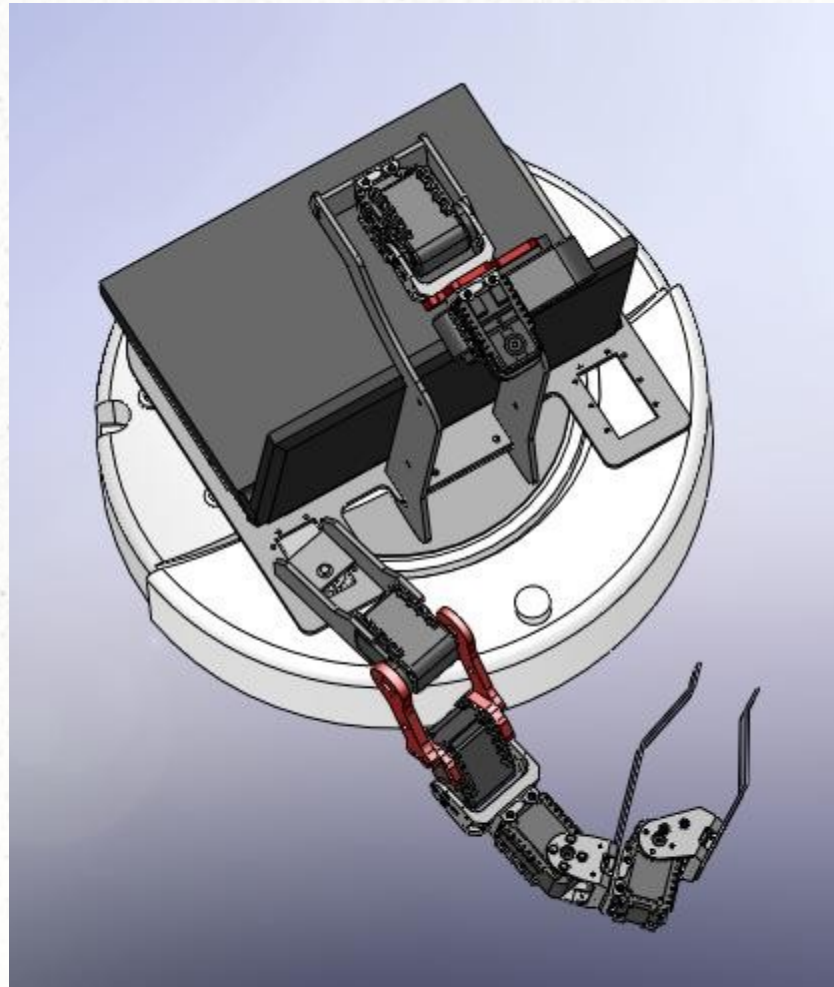
## *Let's Add An Arm*

- Need 3 servos in the same (vertical) plane for independent control of position and orientation.



- Add fourth servo for rotation in the horizontal plane.
- Fifth servo for gripper open/close.

# *Conceptual Sketch*



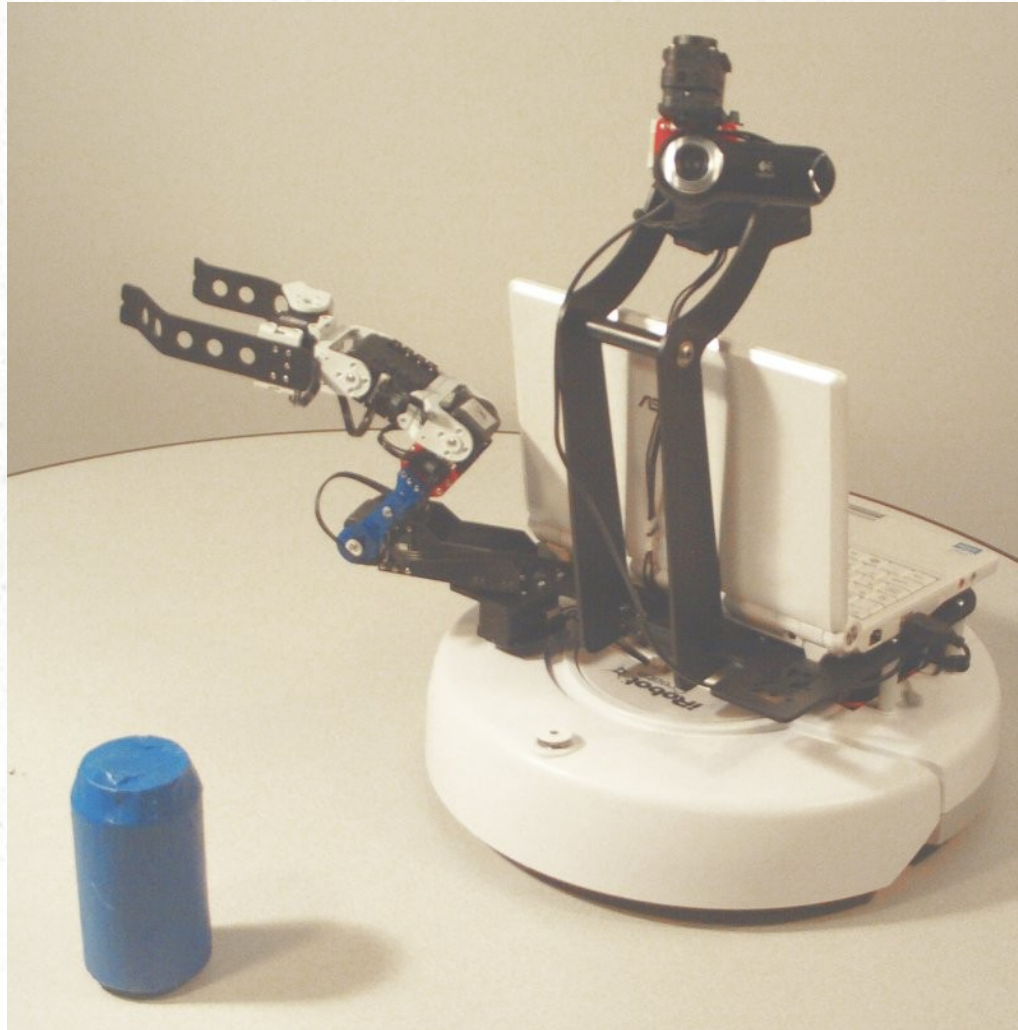
## *What's That Going to Cost?*

- Two RX-28 servos 400
- Three AX-12 servos 135
- Another USB2Dynamixel 60
- Miscellaneous hardware 50
  
- Total for the arm: \$645
- For two arms: \$1230

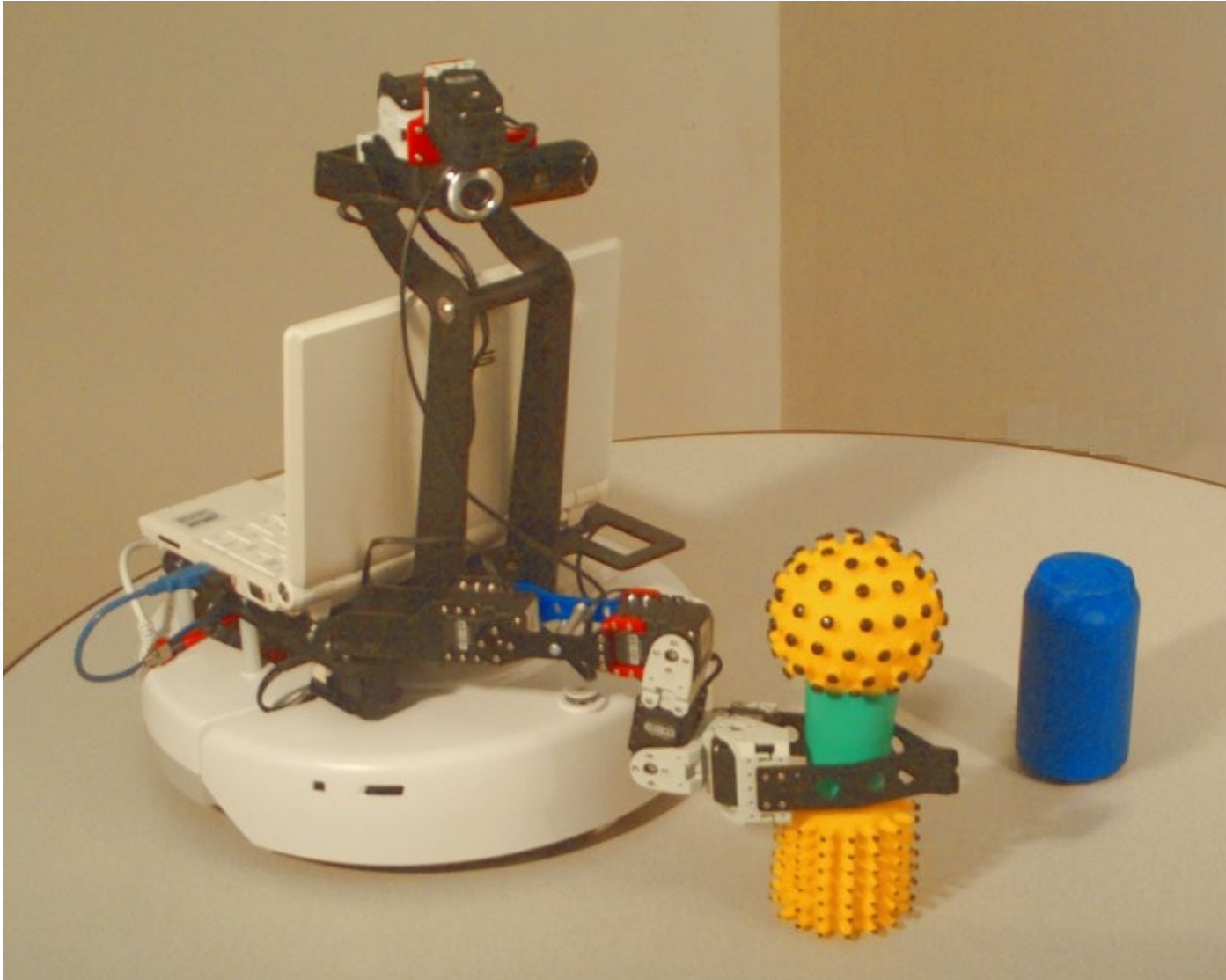
# *Why Do We Need An Arm?*

- Teach kinematics and manipulation.
- Greatly increases the range of tasks the robot can perform.
- Opportunities for hardware experimentation: design new grippers, add force sensing, etc.
- More exciting robotics competition next year.

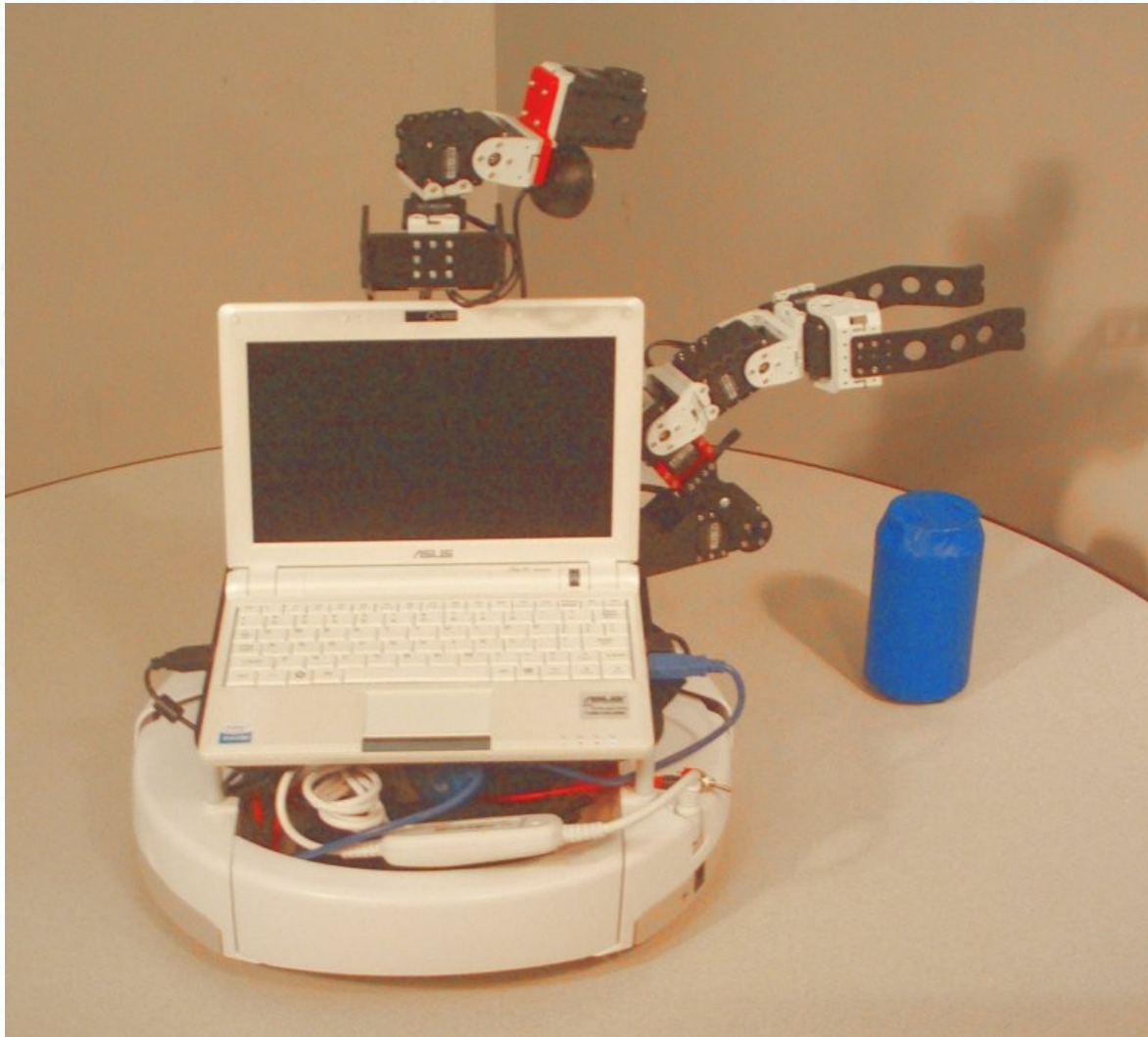
# *First Prototype*



# *First Prototype*



# *ASUS Webcam Faces Backward*





# *Tekkotsu Software Components*

- Kinematic description of the robot (Calliope.kin file)
- Extensions to the Grasper:
  - Grasp planner for acquiring objects
  - Path planner for arm motions
- Integration with the Pilot
- Suite of demo programs

## *Player/Stage and ROS Support*

- Player/Stage and ROS already include support for the Create base, and for webcams.
- Dynamixel drivers.
- Support for the Lynxmotion arm could easily be adapted to this arm: similar kinematics.

## *Possible Hardware Refinements*

- Instead of two USB2Dynamixel boards (bulky and expensive), have one small board that speaks both AX and RX protocols.
  - Currently in development.
- Use a voltage converter to tap into the Create's 18V battery instead of adding a separate battery to power the servos.

## *Making More*

- ARTSI Faculty can decide to upgrade their Create/ASUS robots to Calliope models.
- RoPro Design will be offering Calliope for sale to non-ARTSI schools.
- Could become a short-term standard platform for undergraduate robotics instruction.