CPU: Clothing Picker Upper

16-887 Team 2: Ankita Bhanjois, Pat Callaghan, Iris Dong

Problem Statement

What we are trying to solve:

- Assist people in picking up clothing off the floor.

Challenges:

- Frail and elderly adults may struggle to bend or squat to pick up items
- Clothing on the floor → messy environment; trip hazards
- Static system is inconvenient; maneuverable system is desirable

Feedback from Midterm:

- Why are we picking up for delivery? Why no bin?

Population/Project Importance

Population:

- **Targeted population:** frail, elderly adults; caregivers for long-term at-home patients
- Provide at-home technology to **assist** in the **pickup and delivery of clothing**

Medical Importance:

- 39% of adults had back pain
- Arthritis reported in 50% among adults 65+ according to the CDC
  - 31% for ages 45-65 years old
- “Frailty” increases with age

Assumptions

- All operations take place in a obstacle-free, predefined space
- Clothing items involved in testing can be grasped by the gripper
- Ambulatory individual will be able to retrieve item from standing
  - “Delivery” for our project is lifting object to a specific height

Stakeholder Interactions

Dr. William Mills

- Senior VP for Medical Affairs for BrightSpring Health Services
- Confirmed the usefulness of our project
- Ensured that our project wouldn't discourage frail adults to exercise/be active

Iris's Grandparents

- Bending over is tough at an old age and can cause complications such as strokes, tripping over, etc
- Currently use a grabber with a 1 meter range to help with unstable hands and not enough strength
- Items often dropped include food, phone, and clothes

(Post-Midterm) Stakeholder Interactions

Audrey Burgoon

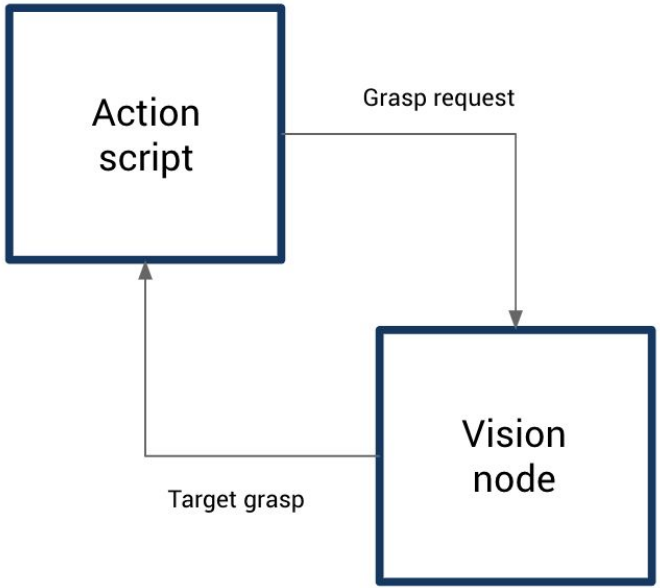
- Chief of Staff at Asbury Heights
- Our project would not work in facilities, but would be beneficial for long-term housebound patients
    - There are so many employees in a facility in charge of cleanup and pickup of objects
- **Pick up from surfaces would be also beneficial**
- **User starting up the protocol should include a initiating command**

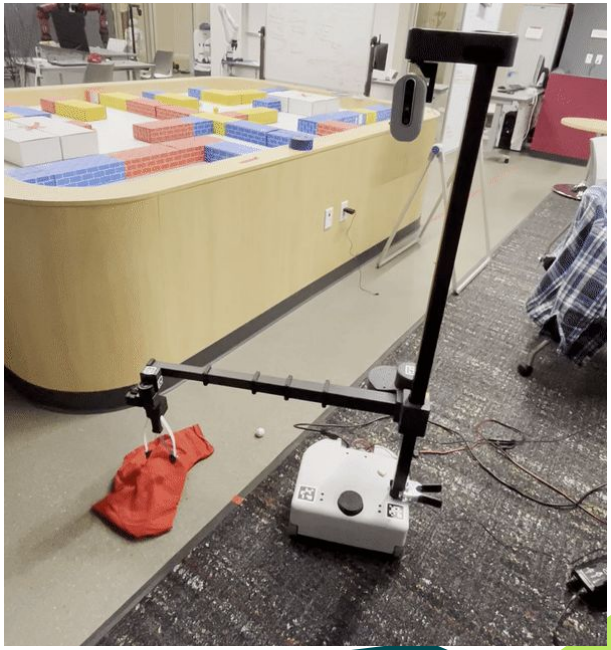
Rosemarie Malanoski

- Employee at Vincentian Schenley Gardens (personal and memory care facility)
- Staffing within facilities would not undermine importance/relevance of our project
- Targeted population could include handpicked individuals within the facility
    - **Independent living**
- Project could be beneficial for any individual in aging process
- **More helpful for caregivers**

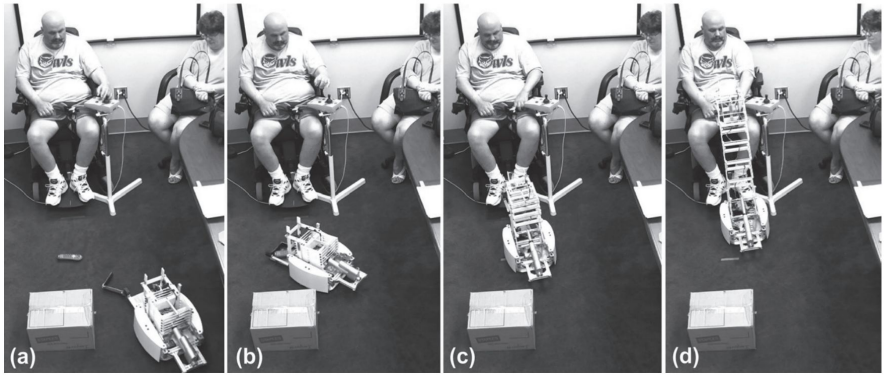
1.
Prior work

Midterm Project

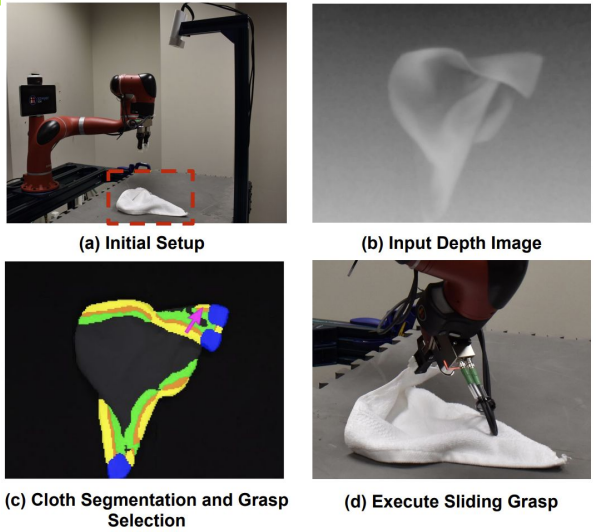




Midterm Project: Literature Review



Dusty: an assistive mobile manipulator that retrieves dropped objects for people with motor impairments

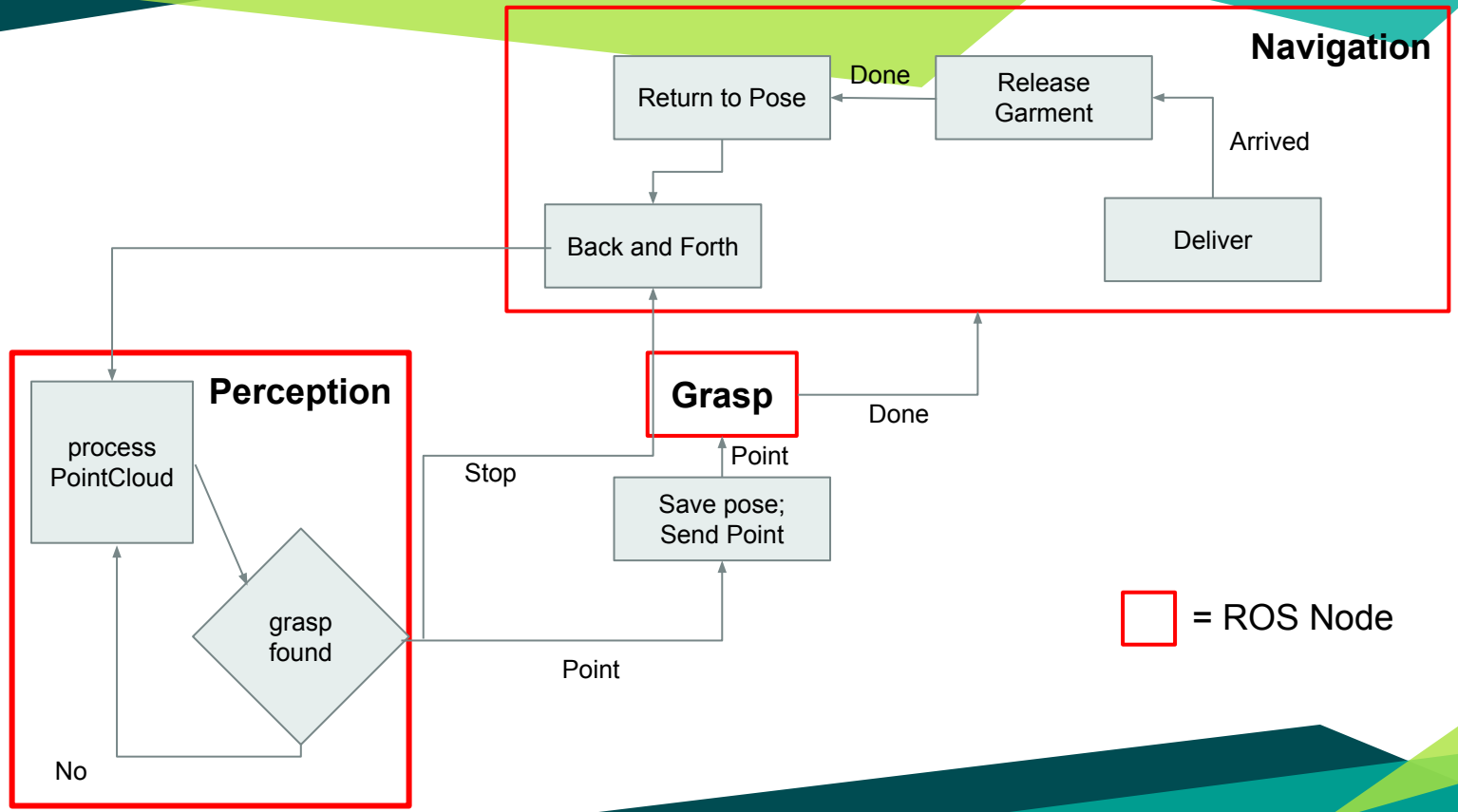


Cloth region segmentation for robust grasp selection.

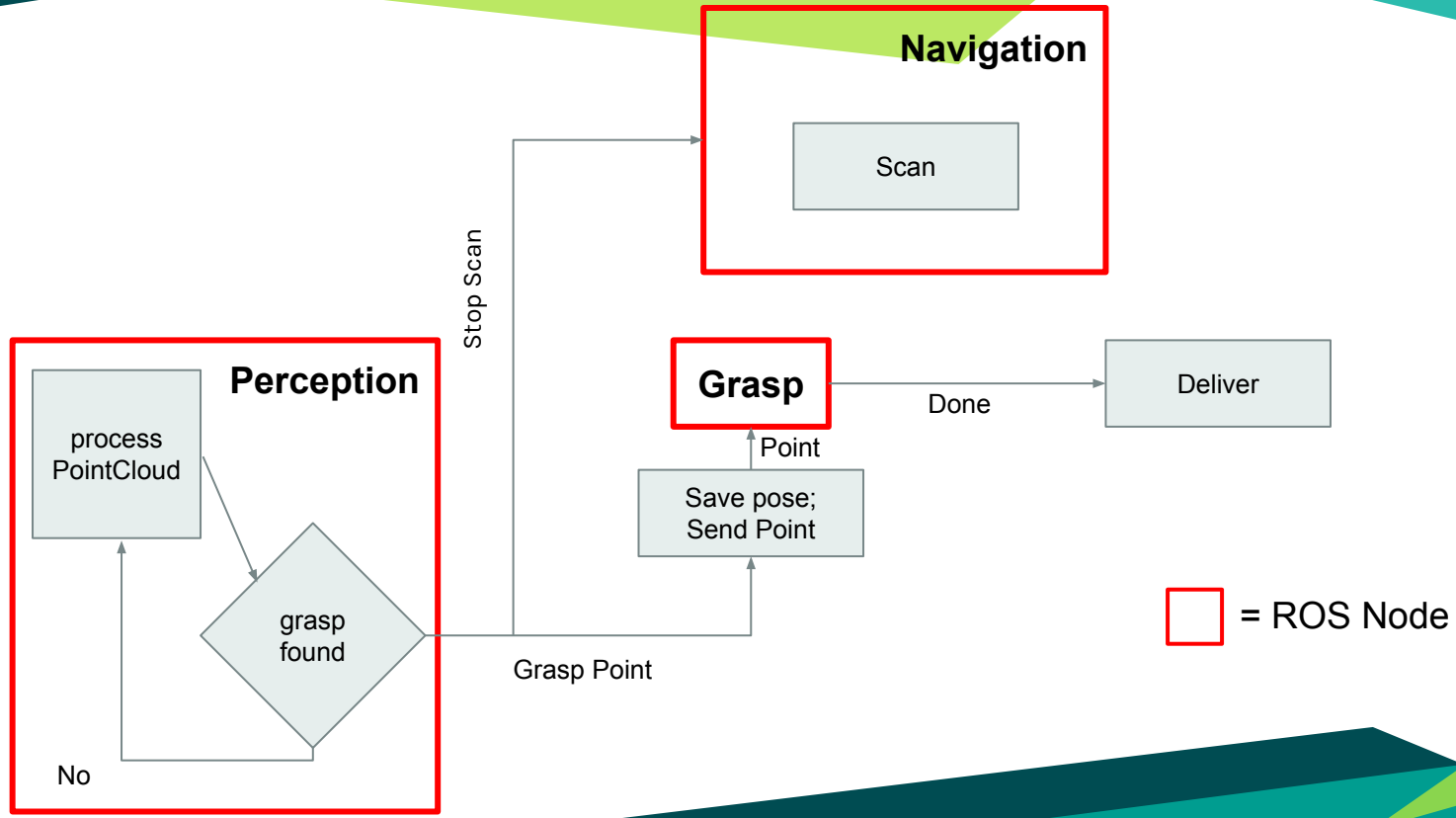
2.
Implementation details

Nodes

Intended Node Architecture

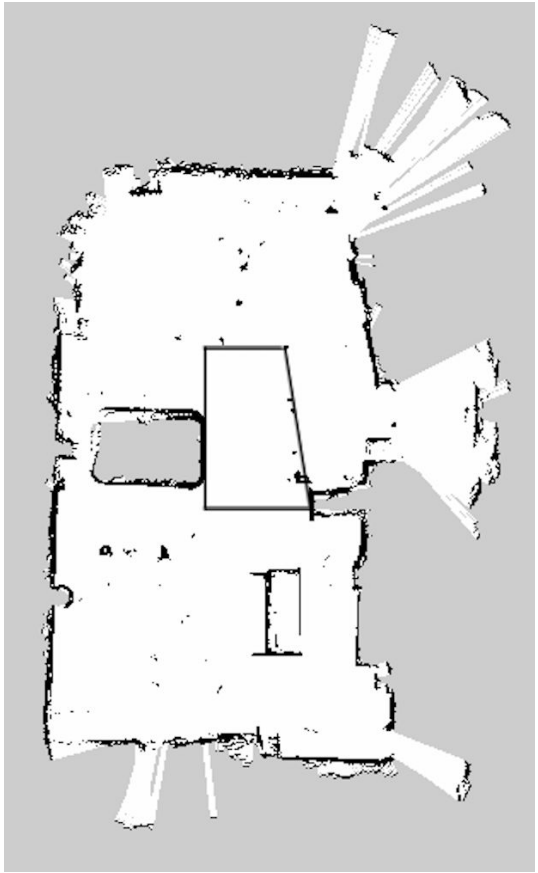


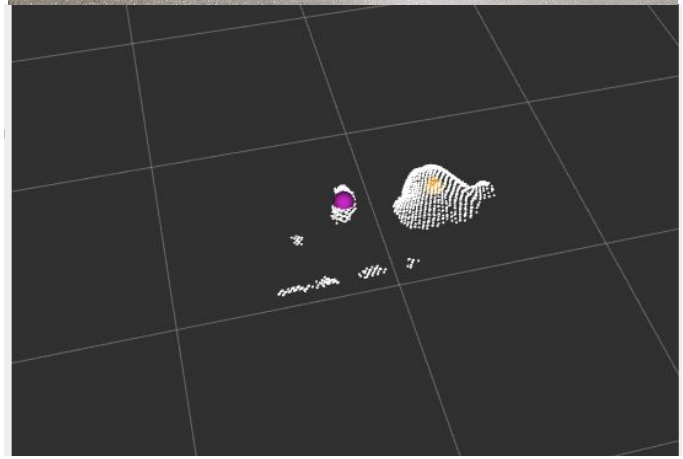
Pivoted Node Architecture



Navigation

- Mapped the AI Makerspace in Tepper and added Keep-Out Zones
  - Ended up being unnecessary for our final implementation
- ROS Node:
  - Moves forward 1.5 meters and scans the area for an object detected by the PointCloud
- Re-scoping done from midterm-present time:
  - Simply scanning in place for object grasping





Object detection

- Point Cloud with height and distance thresholds
- DBSCAN to cluster pointcloud for finding grasp points

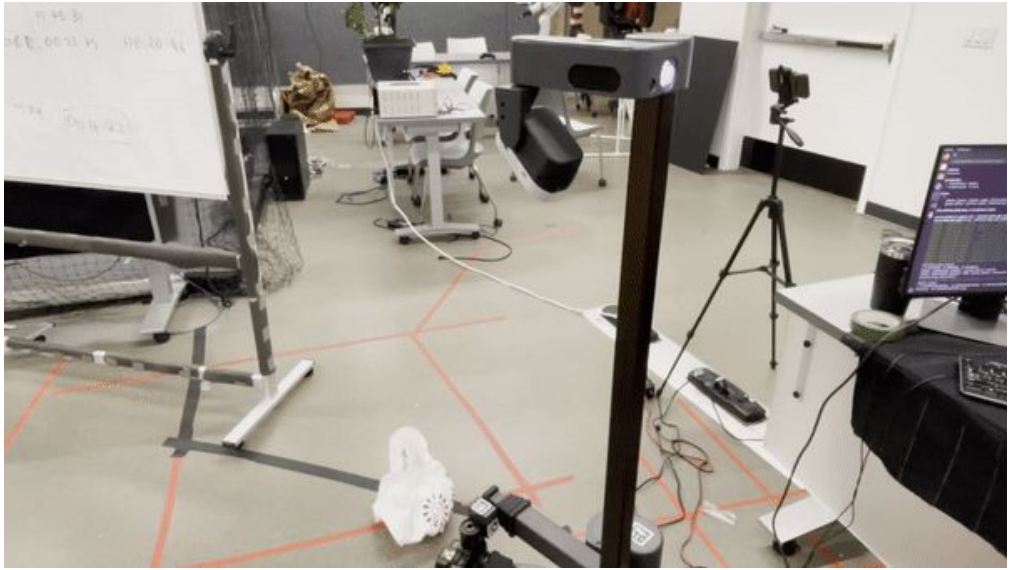
Object grasping

Rotate Stretch such that its (negative) y axis aligns with the grasp point

Compute distance and extend arm

Drop the arm to that grasp point’s z-coordinate

Close gripper and lift arm

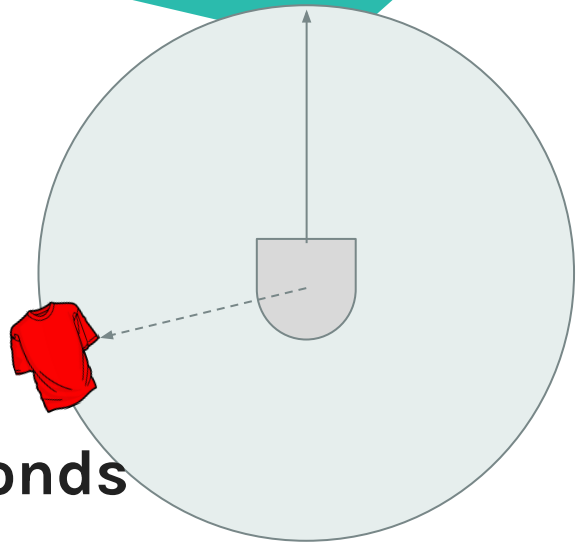


DEMO VIDEO

3.
Evaluation

Times to Complete Task

Task: Clothing ~0.5m from base, ~100° counterclockwise from x-axis



Average Time of Successful Trials: 33 Seconds

Average Time of Failed Trials: 26 Seconds

- Arm failed to grasp object

Quantitative Evaluations/Trials

Object/Grasp Point Detection via PointCloud (Static)

- ~75% success rate
- Failures due to: *Objects outside threshold bounds*

Object/Grasp Point Detection PointCloud (W/ Navigation Node)

- ~50% success rate
- Failures due to: *Objects outside threshold bounds, people in field of view*

Completion of Object Grasp and Pickup

- Out of 10 trials: 10% success rate
- Failures due to: *Improper base alignment; Improper descent distance*

4.
Conclusion

Future Work

- Pick up multiple clothing items in whole room/area
- More sophisticated object detection
- More advanced navigation scheme
  - Move around and scan
  - End at delivery zone