

PackBot

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Bharath S, Quinn K, Sowmiya Narayanan G

Our Goal

- Package sorting and delivery within a building is arduous and time consuming
- PackBot is an autonomous agent that can deliver packages to several locations within a closed environment.

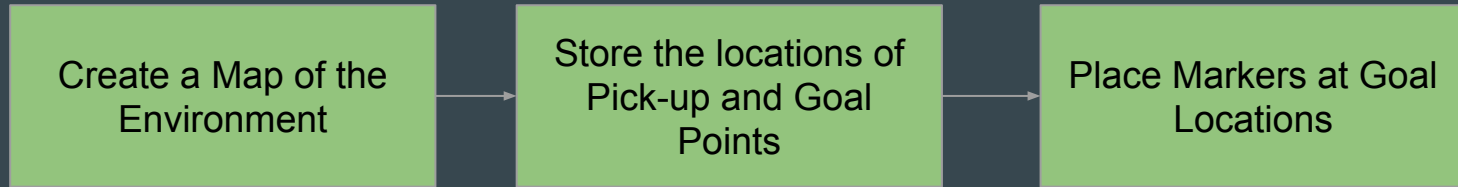


Hardware Used

- TurtleBot3
- RPi 3
- Logitech USB Webcam
- Lidar
- DYNAMIXEL Motors
- OpenCR Board
- Lenovo YOGA (Remote PC)



Initial Setup



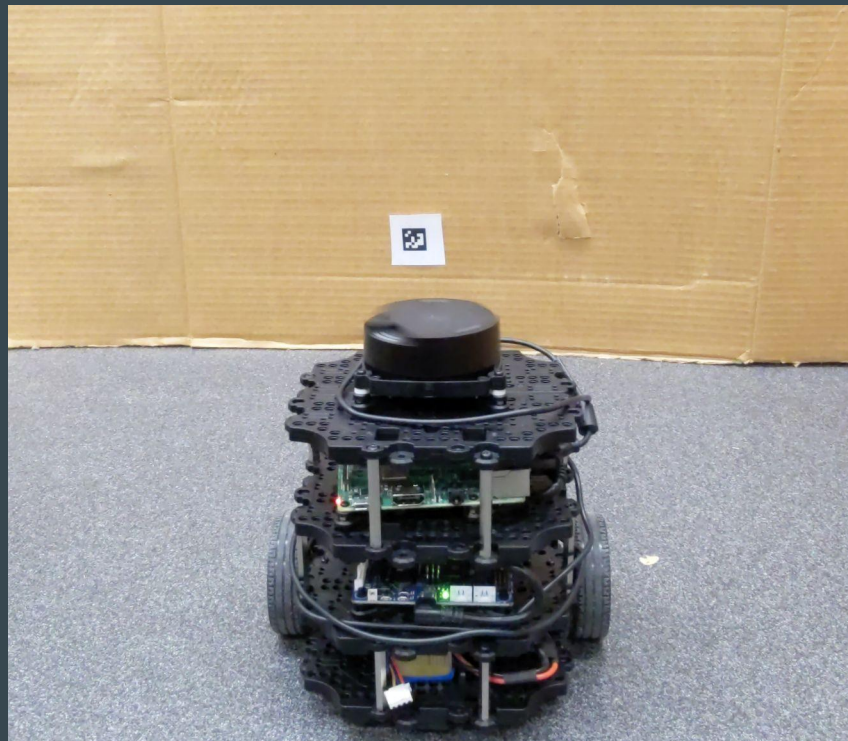
Environment



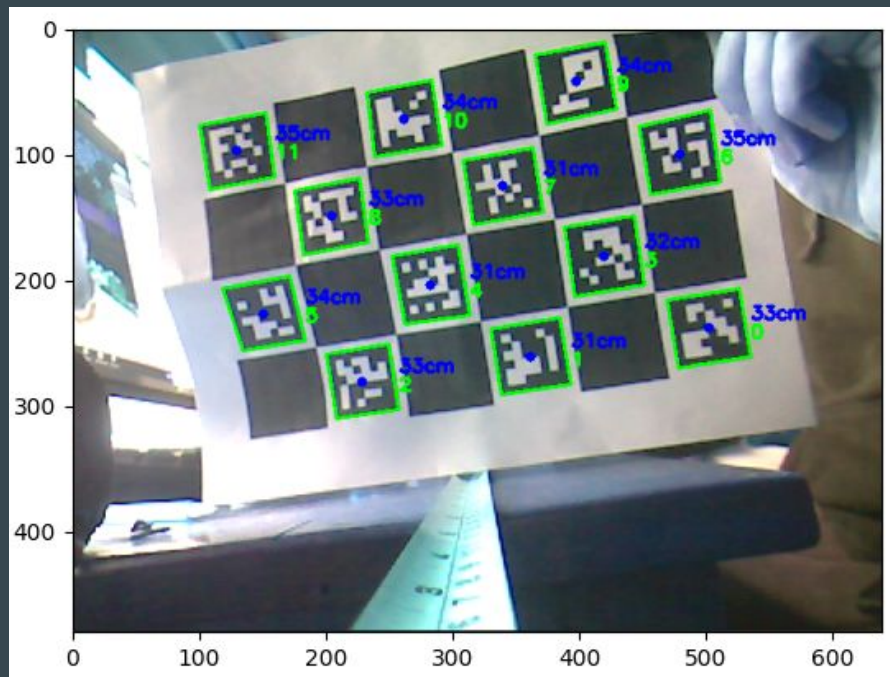
Rviz Map



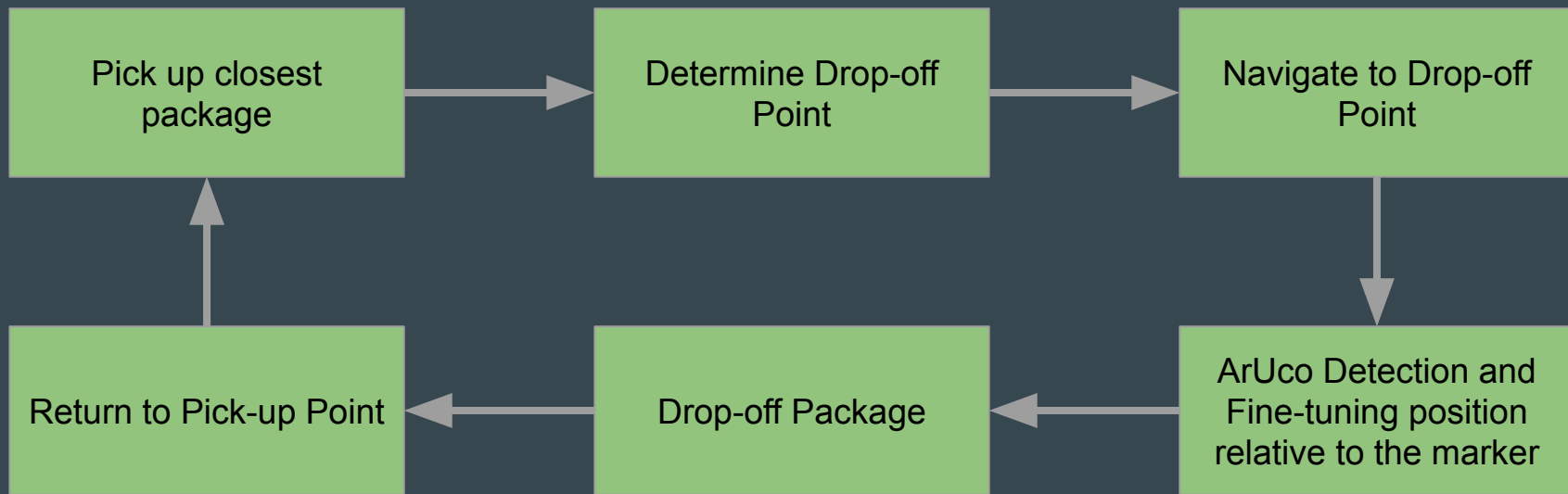
ArUco Marker Placements



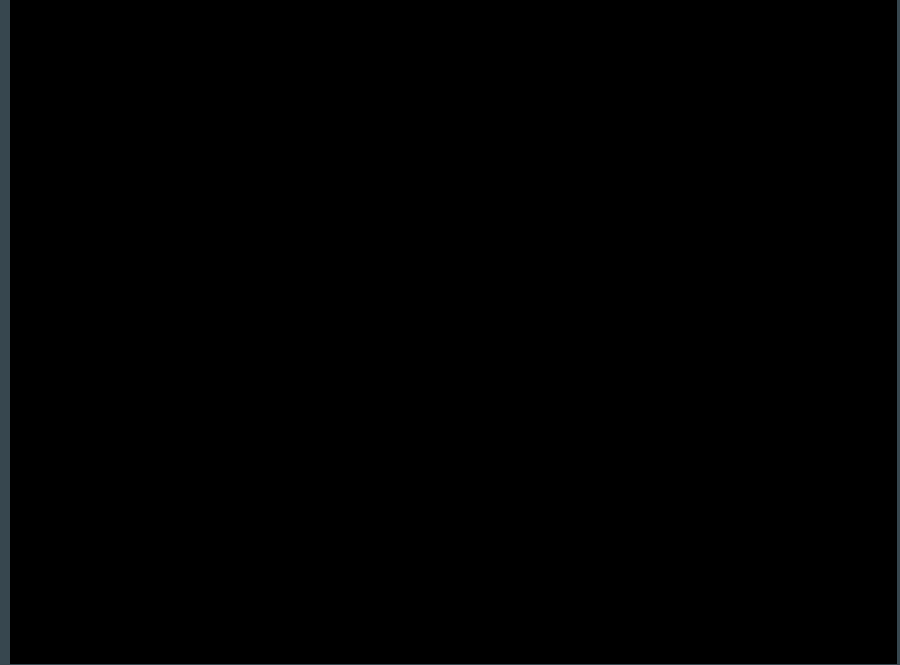
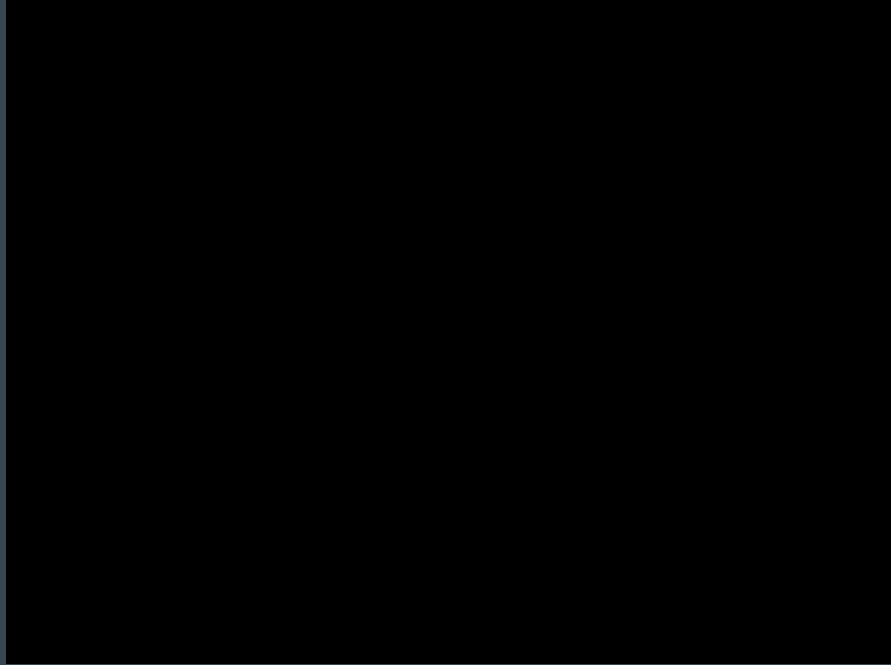
ArUco Marker Detection



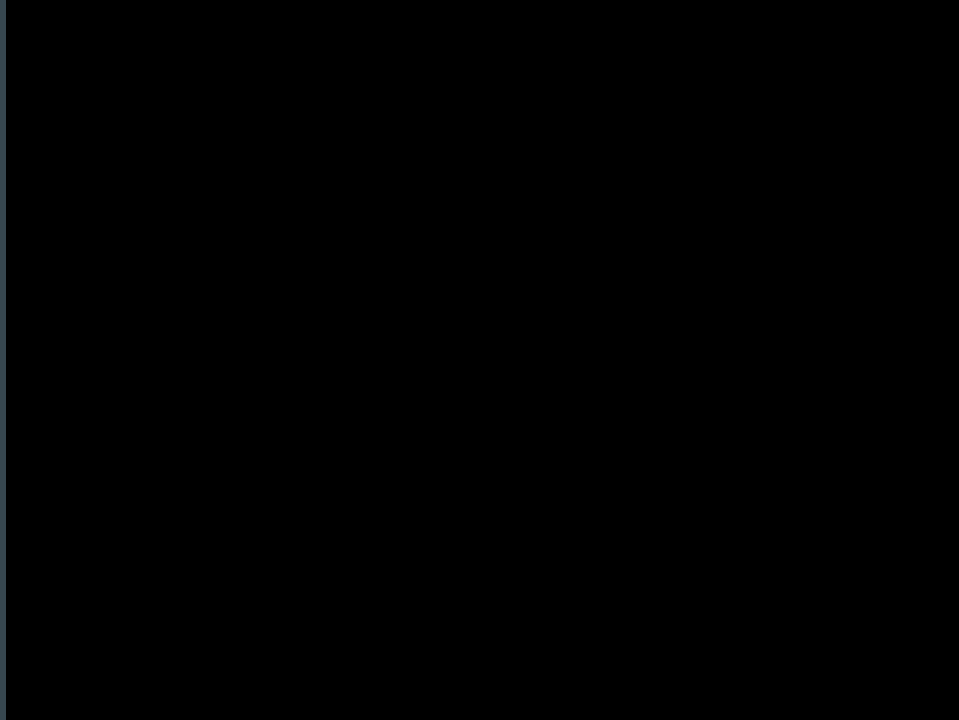
Robot Task Flow



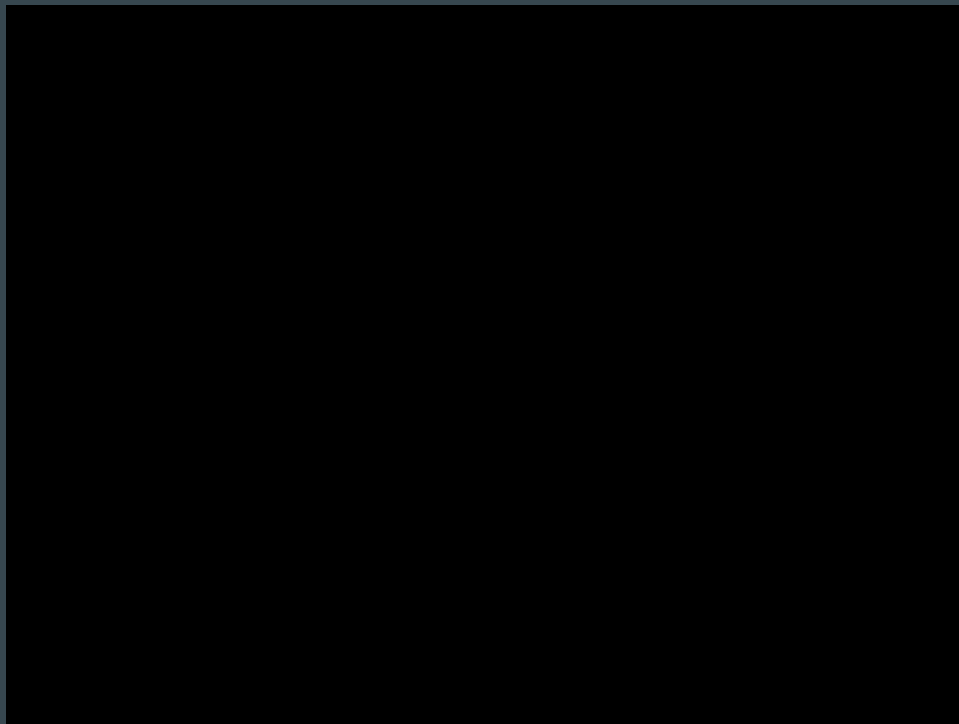
Demo 1: Scan Block → Go to Drop → Back to Pickup



Demo 2: Align and Close Gap between Marker



Demo 3 : Robot Struggles



How's this working?

1. Node continually receives images from `/usb_cam/image_raw`
 - a. Scans for closest Aruco and stores ID
2. Publish `Twist()` messages to narrow down angle and get block into gripper
3. Send `move_base` command to drop point based on ID
4. Once again publish `Twist()` messages to align robot with drop point marker
5. Go back to pick up using `move_base`

Challenges and Lessons Learned

- Calling `move_base` within image callback can cause various issues
- `Move_base` in general is very sensitive to surroundings, not very dynamic for obstacle avoidance, often overshoots orientation angle
- The Turtlebot has a hard time driving backwards
- Using raw images when sub/pub can cause huge callback latency

Future Enhancements

- Adding a vision-based manipulator to pick the packages/blocks to be transported.
 - Potential for electro magnets to pick up and drop boxes
- Test different path planning algorithms (ex. RRT)
- Make map building and aruco drop off point localization autonomous
- Multi-robot navigation and fleet management (Long Term)

Sources

- Move_Base Action Client
 - <https://hotblackrobotics.github.io/en/blog/2018/01/29/action-client-py/>
- ArUco documentation
 - <https://docs.google.com/document/d/1QU9KoBtjSM2kF6IT0jQ76xqL7H0TEtXriJX5kwi9Kgc/edit>
- Python ArUco documentation/examples
 - https://mecaruco2.readthedocs.io/en/latest/notebooks_rst/Aruco/Aruco.html

Thank You !

Questions?