

Background

Several tasks that are currently performed by humans can be offloaded to robots for **reducing human effort**.

Human-Robot Interaction (HRI)

Goal: Developing algorithms to improve HRI in two specific ways

1. Team Efficiency
2. User Experience

Problem

- Currently HRI algorithms are tested with few environments and few users
- Unknown limits to where an algorithm can fail in different environments

Solution: Test algorithms in multiple simulation environments followed by **real user study in key environments**.

Parceling Task

- **A human and robot will collaborate** to write addresses on 4 packages.



Figure 1: Task setup

- The robot will be coded to hold a package according to where the human is headed.
- The human will write the address on the package and the robot send it off.

User Interface

Why do we need a User Interface (UI)?

UI is needed for humans and robots to **communicate** with each other

What did I do?

- Learned basics of python and PyQt5
- Changed buttons from parts to actions
- Added timer to uncheck the buttons

ROS Subscriber

What did I do?

- Learned basics of ROS [1] (Robot Operating System)
- Wrote a ROS subscriber node in Python by referring to a C++ code

```
1 #!/usr/bin/env python
2 # License: licensed for brevity
3 import rospy
4 from std_msgs.msg import String
5
6 def talker():
7     pub = rospy.Publisher('chatter', String, queue_size=10)
8     rospy.init_node('talker', anonymous=True)
9     rate = rospy.Rate(10) # 10hz
10    while not rospy.is_shutdown():
11        chatter_str = "hello world %s" % rospy.get_time()
12        pub.publish(chatter_str)
13        rate.sleep()
14
15 if __name__ == '__main__':
16    talker()
17 except rospy.ROSInterruptException:
18    pass
```

Figure 2: ROS tutorial [1]

Camera Calibration

Why do we need to Calibrate a Camera? It was needed so that the camera could **accurately detect** april tags. April tags were used to identify packages.



Figure 3: Calibration process

With the checker-board [2], the camera was allowed to detect points in different positions when moving boxes with april tags.

URDF/Task Environments

Why do we need a URDF?

A **Unified Robot Description Format (URDF)** is a format used to define a body put in simulation with certain dimensions and color.

What did I do?

Created multiple URDFs for the packages and represented the environment in RViz simulation

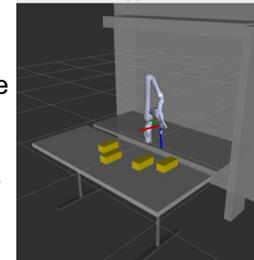


Figure 4: RViz setup

Impacts

- Identify when an HRI algorithm will **fail** to ensure usage of the algorithm to its maximum potential.
- **Safety** of users will be much better
- Evaluate effectiveness of HRI algorithms will help other researchers identify problems for future research

Bibliographies

[1] <http://wiki.ros.org/ROS/Tutorials/WritingPublisherSubscriber%28python%29>.

[2] http://wiki.ros.org/camera_calibration/Tutorial/s/MonocularCalibration

Learnings throughout the 7 weeks

1. **Learning to read python** and basics of coding. Learning to see relationships between code.
2. **Writing a ROS subscriber**
3. **Calibrating a camera**; using skeleton tracking, and learning matrix transformations
4. **URDF** and task environments

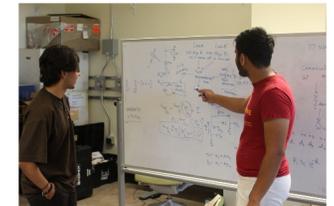


Figure 5: Discussing need and impact of evaluating HRI

Acknowledgements

I would like to thank my awesome mentor, Heramb, for providing me with his knowledge throughout this summer. I would also like to thank Professor Nikolaidis for allowing me to be apart of the lab this summer. Additionally, I would like to thank professor Murali Annavarm and Meisam Ravaviyayn for granting me a scholarship and the opportunity to follow with META. TELACU also helped recommend me and gave me this awesome opportunity so special thanks to them. I can not forget SHINE faculty, thank you for making SHINE happen! Lastly, I would like to thank my two teachers who wrote my letters of recommendation, Ms. Gatchell, and Mr. Moralia.