

Human Friendly Robotics: SaphariShots

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Agenda

- Introduction
- Communication Architecture
- User Interaction
- Face Recognition
- Cup Finding
- Manipulation
- Conclusion

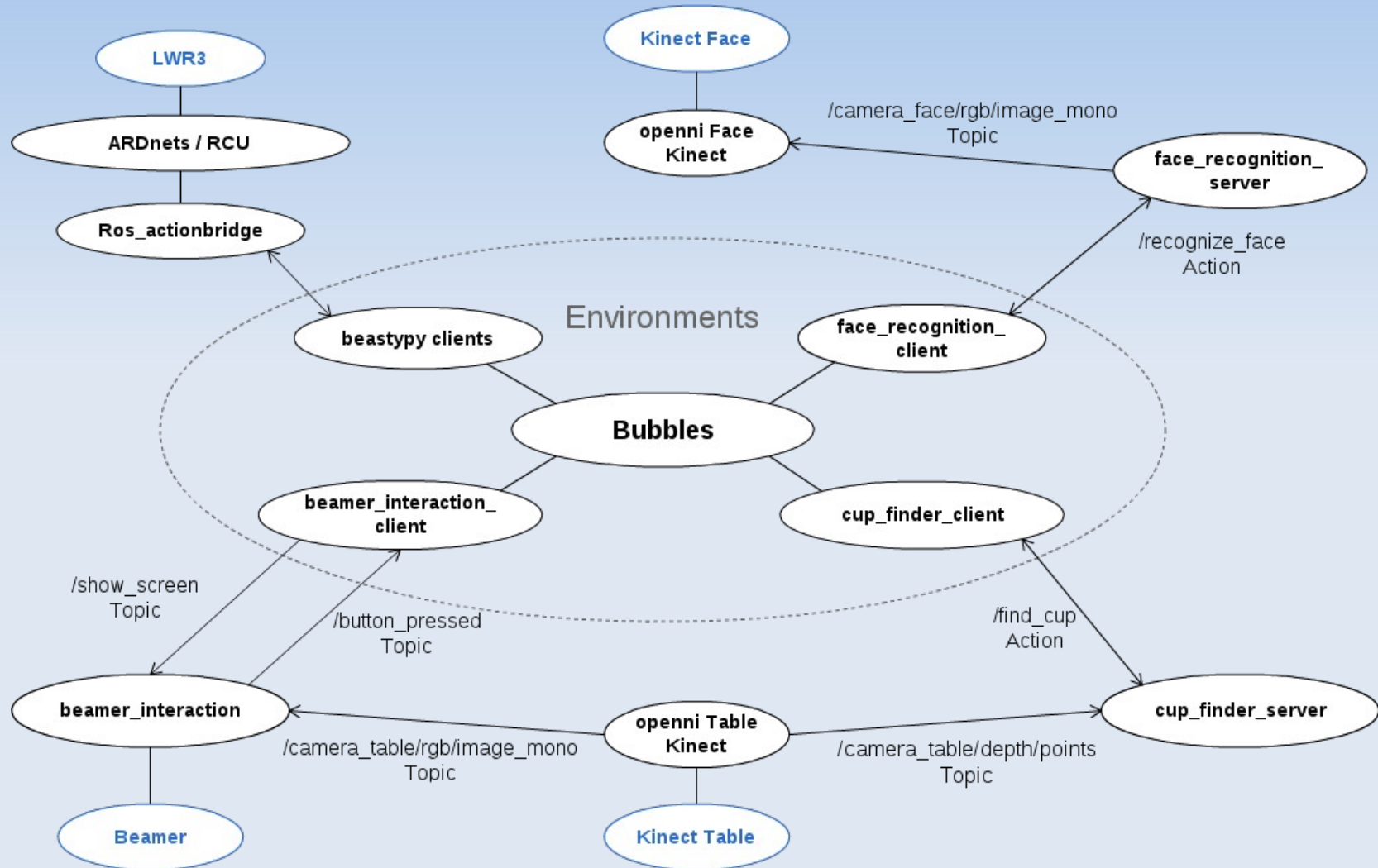
Introduction

- Goal: Automated serving of medicine
 - To the correct patient
 - Flexible
 - Intuitive user interface
 - Error handling

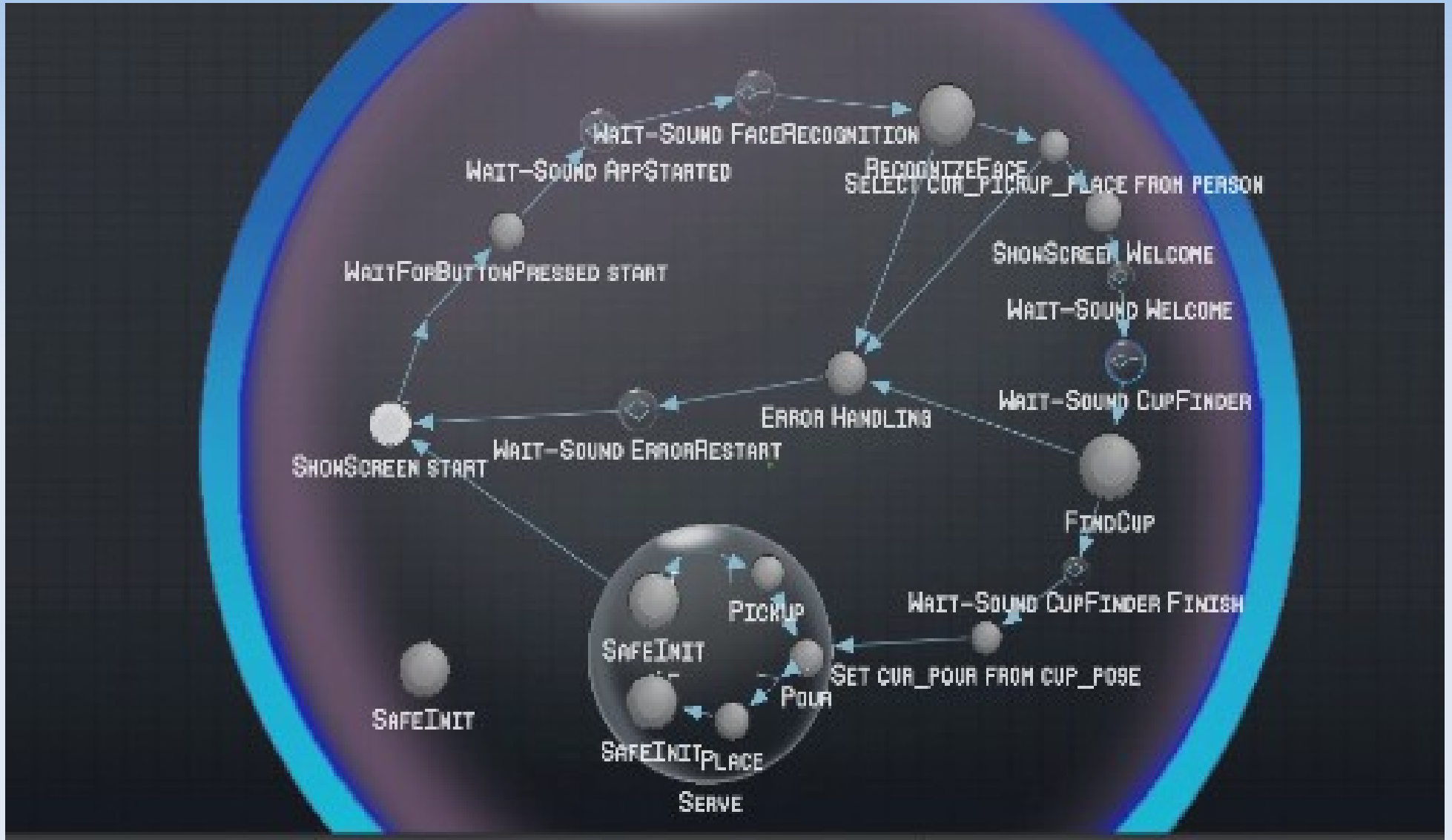
Introduction



Communication Architecture



State Machine



User Interaction: Sound

- Sound feedback has big influence on **human-computer interaction**
 - Sensitive for warnings
 - Feeling more comfortable
- Complete control of the robot based on speech makes the robot more **human-like**
 - <http://www2.research.att.com/~ttsweb/tts/demo.php>

User Interaction: Projector

- Visual communication between Human and Robot
 - Printing instructions on the table
 - Receiving action through computer vision

User Interaction: Projector

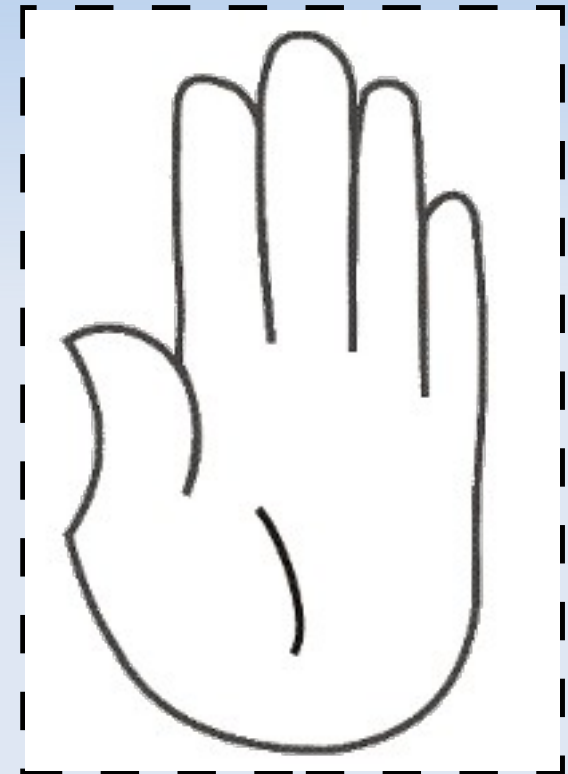
- What the user sees
 - Instruction what to do
 - **Feedback** of what the user was doing

PUT YOUR HAND INSIDE
THE SHOWN PICTURE
(APPLICATION STARTED)



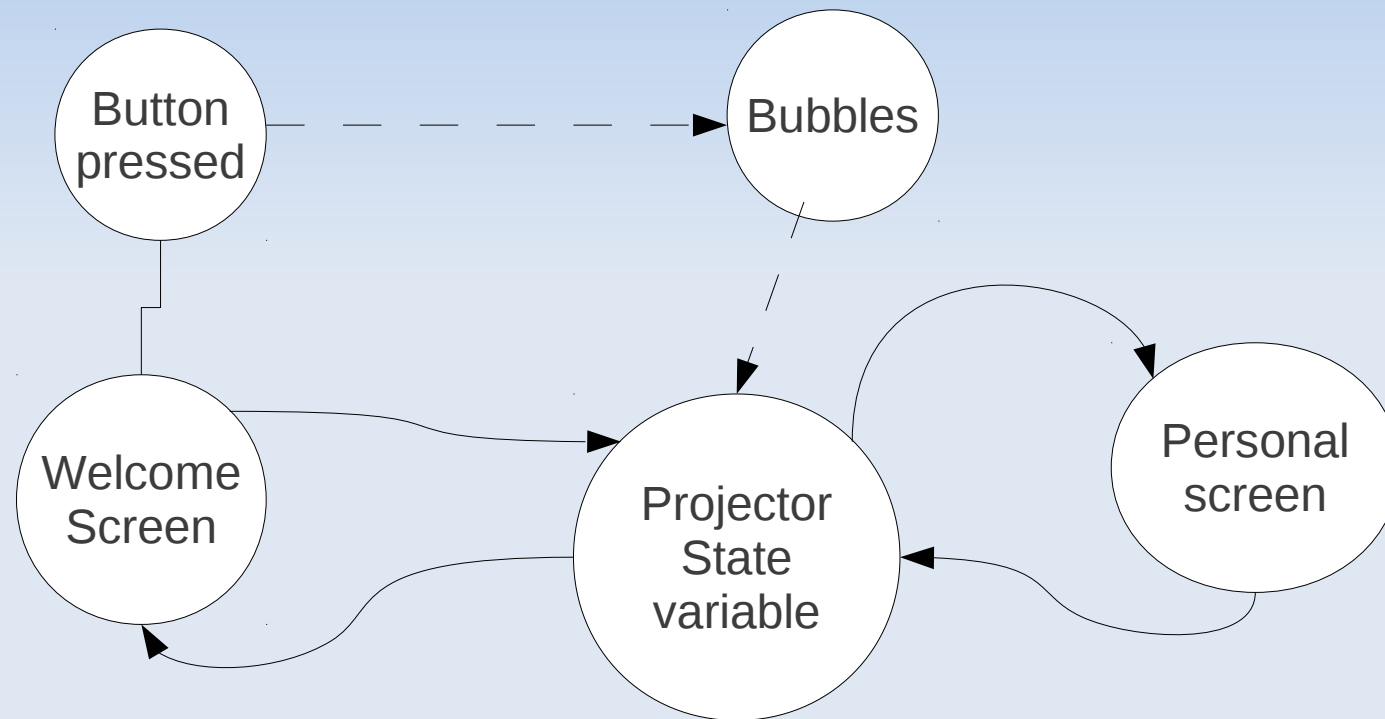
User Interaction: Projector

- What the computer sees
 - Bouding box around **ROI**
 - Grayscale difference above fix **threshold** triggers application
- Could be improved by the help of 3D info based on kinect



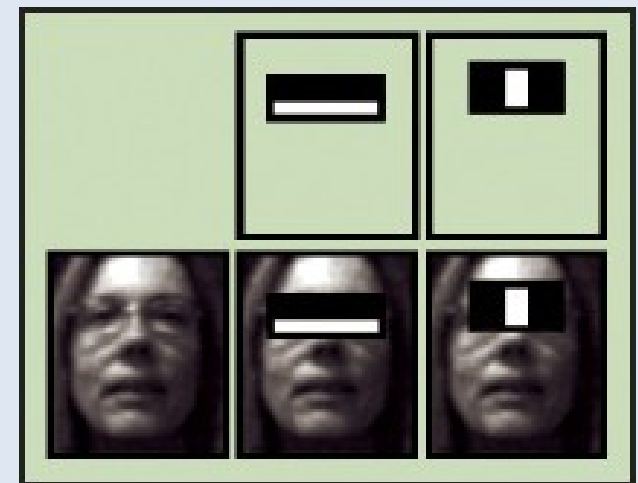
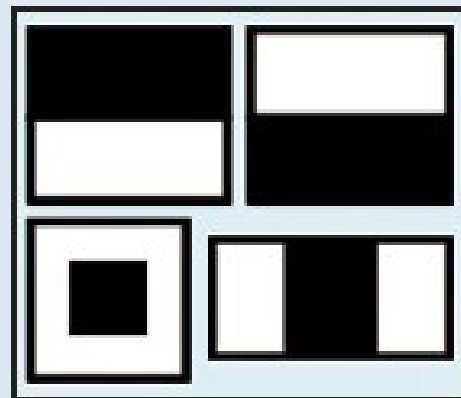
User Interaction: Projector

- Implemented as little state machine



Face Detection

- Haar Cascade Classifier
- Simple rectangular features - Haar features
- Cascaded classifier to combine many features efficiently



Face Recognition

- Eigenfaces / Principal Component Analysis (PCA)
- Reduce dimensionality of data
- Trained data as combinations of Eigenfaces



Face Recognition

- Online training
 - Allows quick and easy training
 - Limited number of people for robust demo



Face Recognition

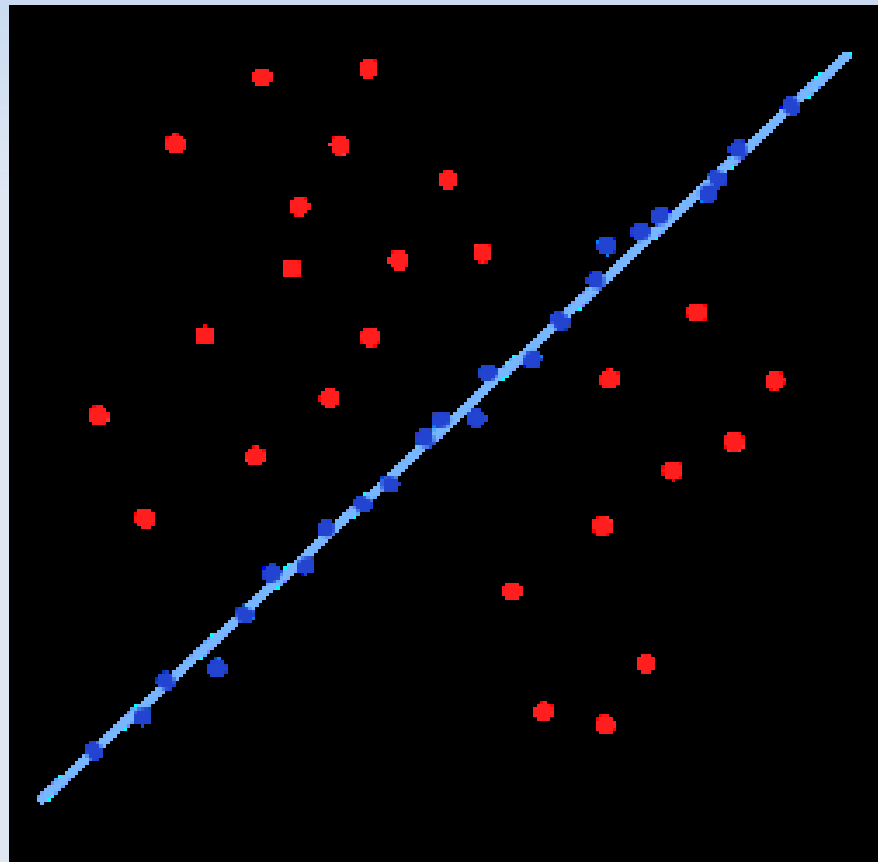
- Integration of OpenCV with ROS
 - Subscriber callback for Kinect data
 - Challenges:
 - Memory integrity, synchronisation, bandwidth
- Integration with Saphari System
 - Actionlib Server to process face recognition request
 - Same framework also used in cup finding

Cup Finding

- Use Kinect → Point Cloud Library
- RANSAC Plane Detection
- Removing far away points
- Removing the plane
- Euclidian Clustering
- Centroid estimation
- Finding the closest cluster
- Transformation to the world frame

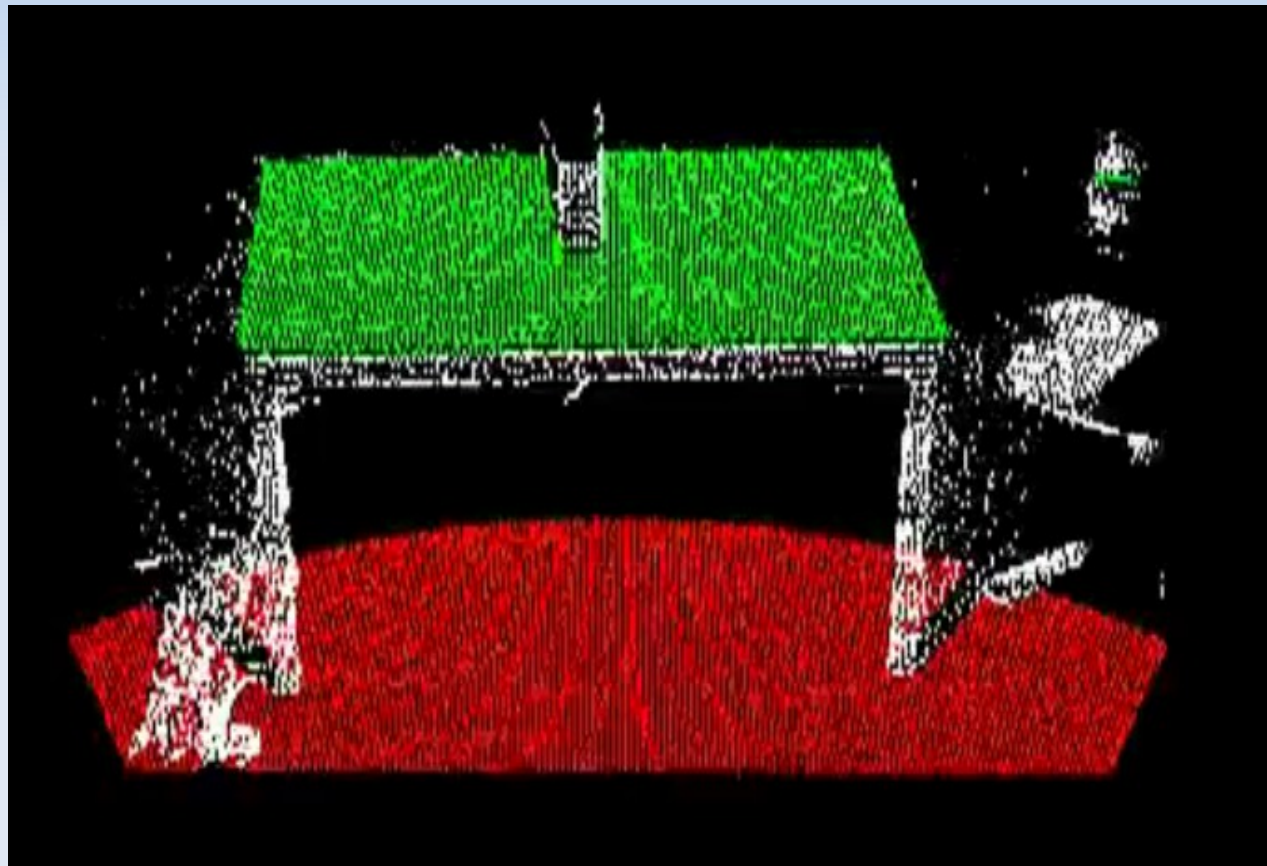
Cup Finding

- RANdOm SAmple Concensus



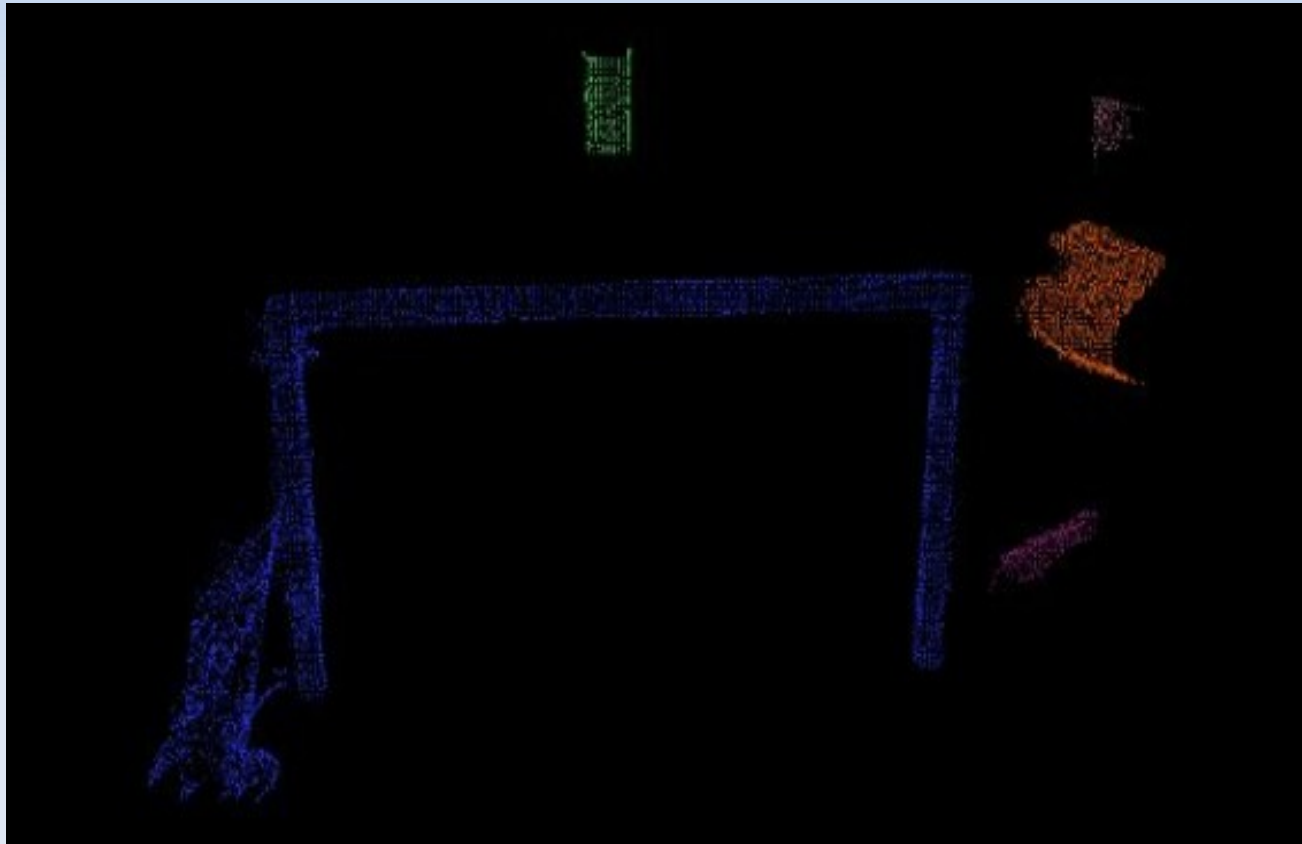
Cup Finding

- RANSAC Plane Detection



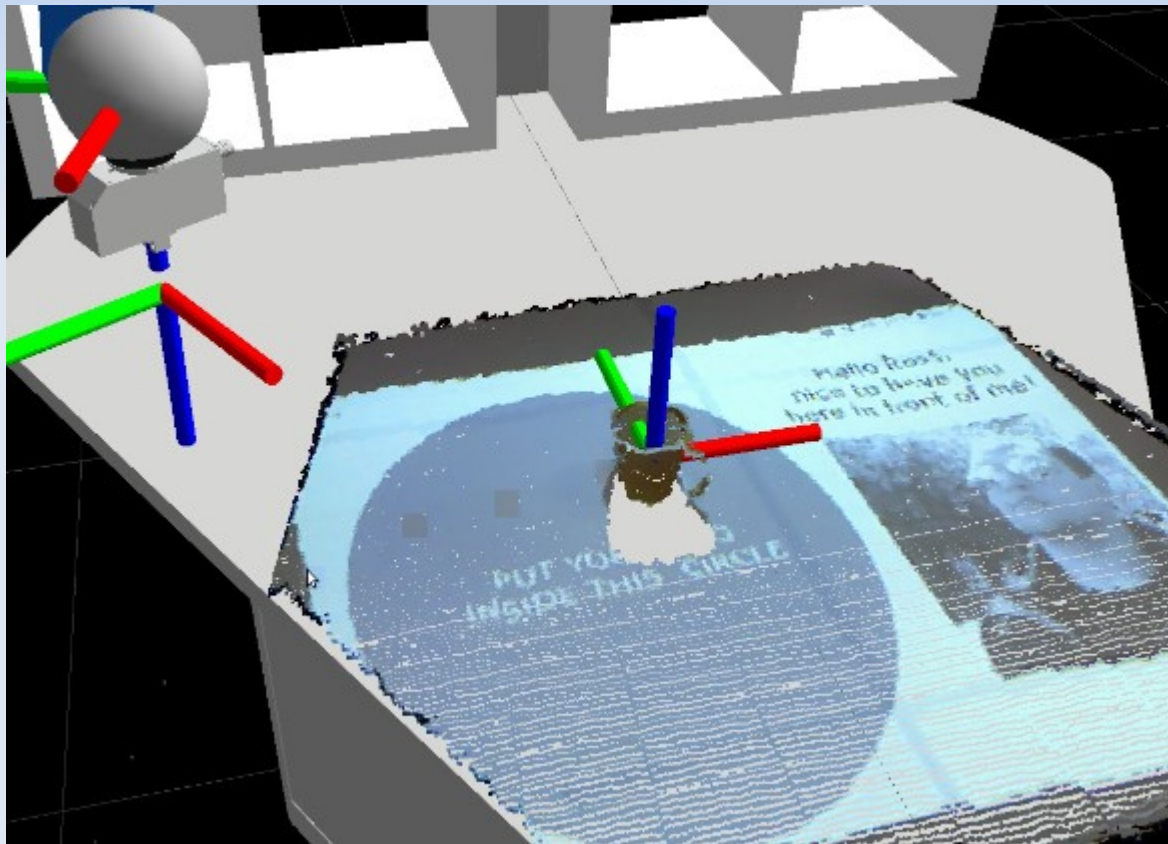
Cup Finding

- Euclidian Clustering



Cup Finding

- Transformation using tf package from ROS



Manipulation

- Parameterized 'Serve' Bubble
- From SafeInit to SafeInit, CollisionStrategy
- 3 Sub-Tasks
 - Pickup, Place – implemented with Grasp
 - Pour – relative Joint movement of wrist
- each with approach positions
- Traversal in between (low stiffness, Elbowfield)

Conclusion

- Goal: Automated serving of medicine
 - ✓ To the correct patient
 - ✓ Flexible
 - ✓ Intuitive user interface
 - ✓ Error handling
- ✓ Robust prototype application
- ✓ Integration of all available devices

Conclusion

- Lessons learnt
 - Integration is non trivial
 - Human friendly involves more than robot safety
 - Good user interface is important

Discussion

- Are there any questions?