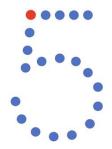




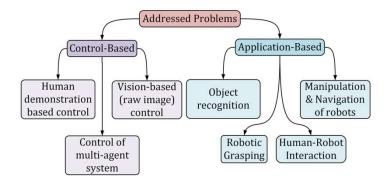
Visual Object Tracking

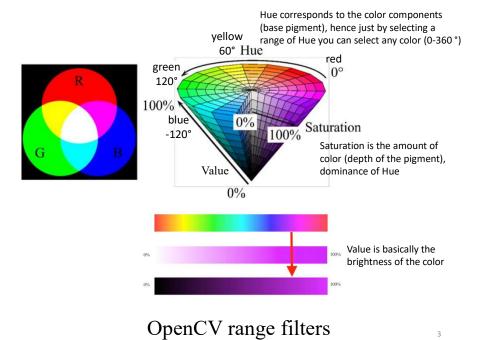


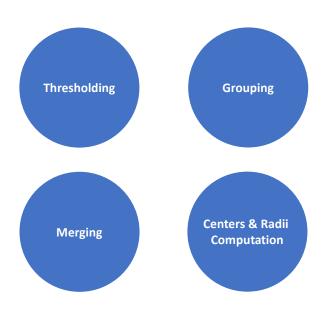
1



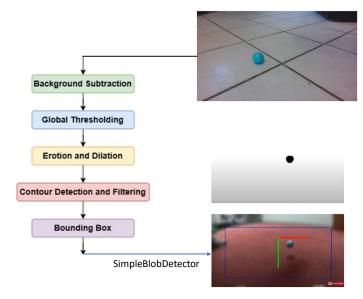
Robotic Vision



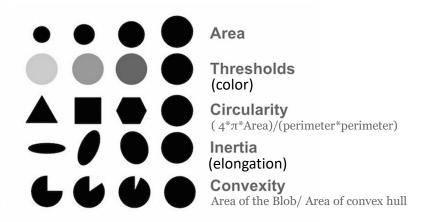




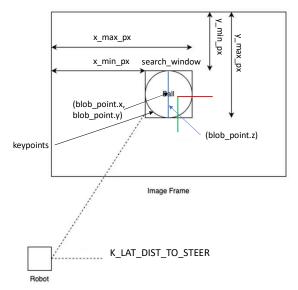
Blob detection algorithms / processes



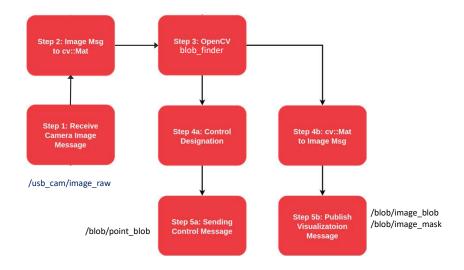
Blob detection pipeline



OpenCV SimpleBlobDetector filters

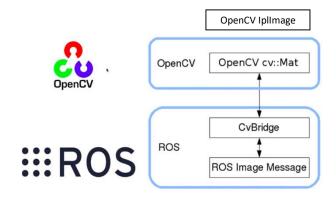


OpenCV blob detection



OpenCV blob finder

cv_bridge package to convert between ROS Image Message and OpenCV frames



OpenCV blob finder

 $\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f_{u} & 0 & c_{x} \\ 0 & f_{v} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} r_{11} & r_{21} & r_{31} & t_{x} \\ r_{21} & r_{22} & r_{23} & t_{y} \\ r_{31} & r_{32} & r_{33} & t_{z} \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$ $= \begin{bmatrix} f_{u} & 0 & c_{x} \\ 0 & f_{v} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & t \\ 0_{1 \times 3} & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$ $= \begin{bmatrix} f_{x} & 0 & c_{x} \\ 0 & f_{y} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & t \\ 0_{1 \times 3} & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$ $= \begin{bmatrix} f_{x} & 0 & c_{x} \\ 0 & f_{y} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & t \\ 0_{1 \times 3} & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$ $= \begin{bmatrix} f_{x} & 0 & c_{x} \\ 0 & f_{y} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & t \\ 0_{1 \times 3} & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$ $= \begin{bmatrix} f_{x} & 0 & c_{x} \\ 0 & f_{y} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & t \\ 0_{1 \times 3} & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$ $= \begin{bmatrix} f_{x} & 0 & c_{x} \\ 0 & f_{y} & c_{y} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & t \\ 0_{1 \times 3} & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 0_{1 \times 3} &$

Camera calibrations

Original Image



Variability in Undistorted Images (exaggerated for illustration purposes)





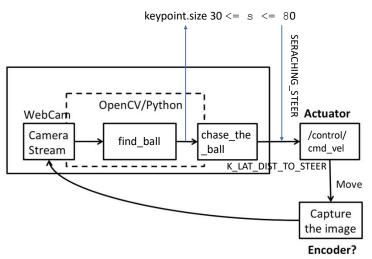


$$\begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$$

6.28041958e+02] 3.42072773e+02] 1.00000000e+00]]

Camera calibrations

11

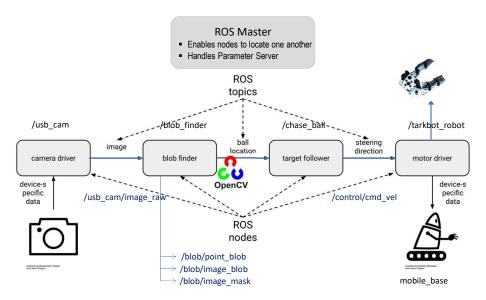


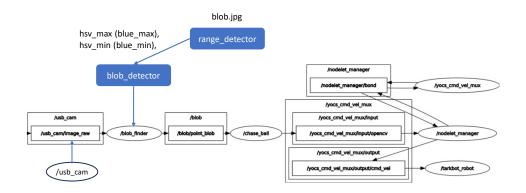
OpenCV KeyPoint steering

\$ roslaunch yocs_cmd_vel_mux test_actions.launch



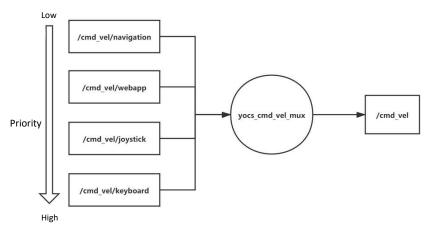
https://github.com/joshnewans/ball_tracker/ https://www.youtube.com/watch?v=We6CQHhhOFo

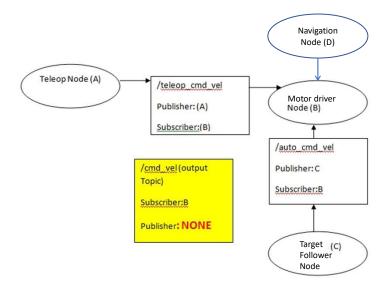






Velocity Multiplexing





Problem of cmd_vel from multiple tasks

ROS

ROS navi stack

node

nodelet manager

kobuki_keyop

Android teleop

nodelet

C++ driver

Topic

Topic

Topic

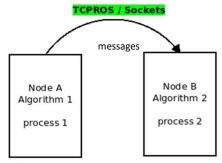
Tarkbot

Tarkbot

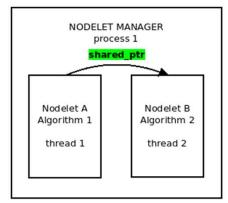
ROS driver

ROS mux package

1



Nodes connect to other nodes directly; the Master only provides lookup information, much like a DNS server. Nodes that subscribe to a topic will request connections from nodes that publish that topic, and will establish that connection over an agreed upon connection protocol. The most common protocol used in a ROS is called TCPROS, which uses standard TCP/IP sockets.



Any communications between them can use the zero copy roscpp publish call with a boost shared pointer.

ROS nodelet

/topic2 /subscriber_node

/publisher_node /topic1

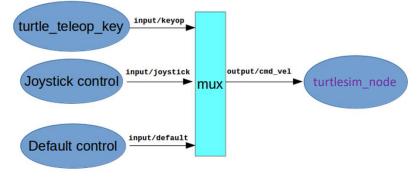
<remap from="topic1" to="topic2" />

/publisher_node /topic2 /subscriber_node

ROS remap

<remap from="/turtle1/cmd_vel" to="/yocs_cmd_vel_mux/output/cmd_vel" />

<remap from="/turtle1/cmd_vel" to="/yocs_cmd_vel_mux/input/keyop" />



ROS remap