

Ros Software Architecture

1 Intro

Ros is an open-source robotics middleware suite. Although ROS is not an operating system (OS) but a set of software frameworks for robot software development, it provides services designed for a heterogeneous computer cluster such as hardware abstraction, low-level device control, implementation of commonly used functionality, message-passing between processes, and package management. (stole definition from Wikipedia)

2 Publisher Subscriber Architecture Model

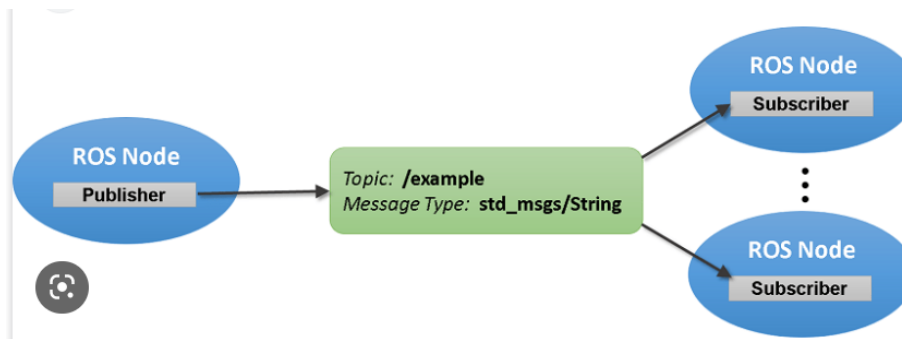


Figure 1:

Nodes: Are usually associated with a python script or c++ object. Nodes can do two main things - publish and subscribe. A node can be both a publisher and a subscriber.

Publisher node: Publish(send) data to a topic(Represented by outgoing edges in figure above).

Subscriber node: Subscribes(listens) to data from a topic(Represented by incoming edges in figure above), then uses a callback function to create desired output from topic data.

Topics: Are the name handlers for where nodes will publish and subscribe to data.

Ros messages: Are objects predefined in ros or defined by the programmer that can be transmitted over topics.

3 System Design

Ros programming is often done using a top to bottom approach. The engineer must design the system architecture(as shown above), then develop(code) the individual nodes of the system.

Advantages:

1. Simplifies documentation and readability of the system.
2. Stores code in modular nodes that can be easily added and removed to any system(increases code re-usability).
3. Increased programming efficiency since nodes can be written in different languages and are allowed to communicate within a ros environment.
4. Ros nodes communicate using asynchronous message passing, which improves performance by simplifying parallelism and making it more accessible to developers.

4 Whats a callback function?

Publisher nodes send data to topics, and subscriber nodes collect data from topics. Each time a subscriber node receives data from a topic, the subscriber node will run a callback function. A callback function is a function, that receives data(input) from a topic asynchronously, and computes the output in separate thread. Each time data is received from a topic a new thread opens and runs the callback function.

5 Whats a point cloud?

A point cloud is a set of 3d points within some frame. Example of devices that gather point cloud data are kinect(xbox), lidar(similar to radar), and stereo camera(uses two rgb cameras to triangulate 3d points).

6 Example of architecture

Design a system architecture using the publisher-subscriber model that from 2D object inferences, the robot moves it head in the direction of individual people. If there is more than one person, the robot creates a list of centroids(representing

the people) and iterates through this list by pointing its head at each person for three seconds. The robot has two measuring devices, a camera which outputs rgb images of what the robot is looking at, and a kinect device that outputs a point-cloud of 3D points measured in the same frame as the camera.

