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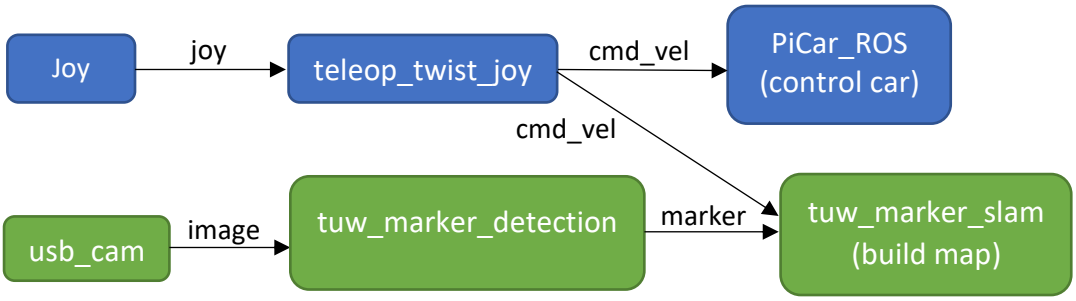
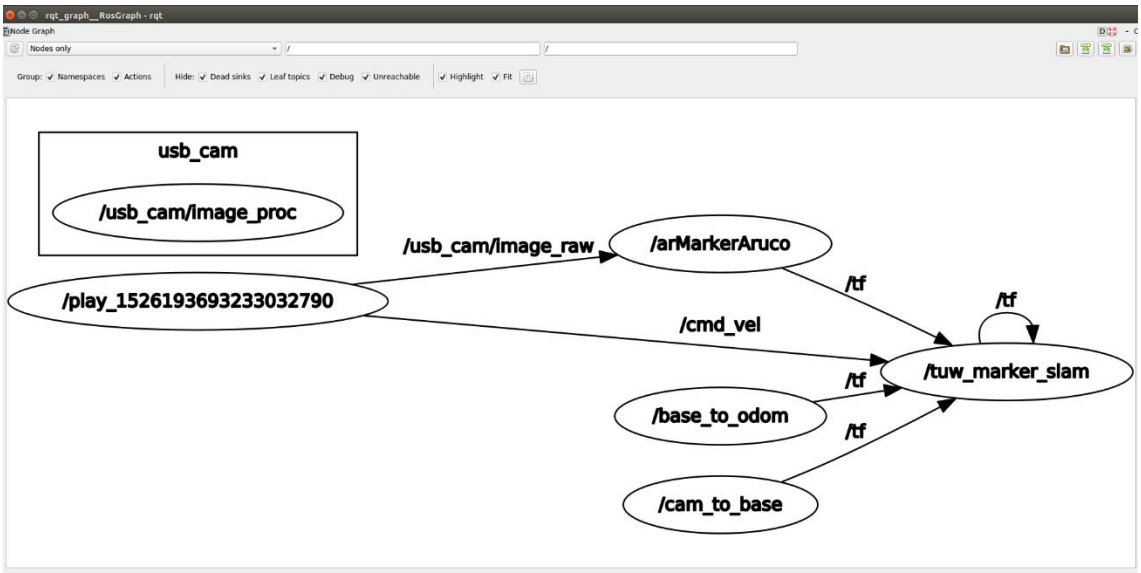
CSE 291D HW3 report

1. Solution
   (1) Use Ubiquity Robotics Raspberry Pi Image to install ROS on Pi
   (2) Use ROS package to build a map
      a. Joy
      http://wiki.ros.org/joy
      b. teleop_twist_joy
      http://wiki.ros.org/teleop_twist_joy
      c. PiCar_ROS
      https://github.com/korzen/PiCar_ROS
      d. rosbag
      e. usb_cam
      http://wiki.ros.org/usb_cam
      f. camera_calibration (for camera matrix calculation)
      http://wiki.ros.org/camera_calibration
      g. tuw_aruco
      http://wiki.ros.org/tuw_aruco
      h. tuw_marker_slam
      http://wiki.ros.org/tuw_marker_slam





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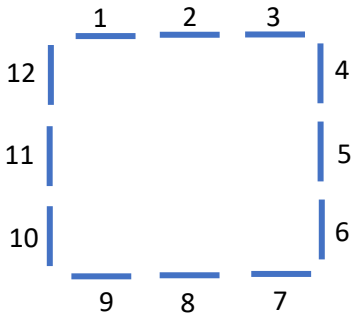
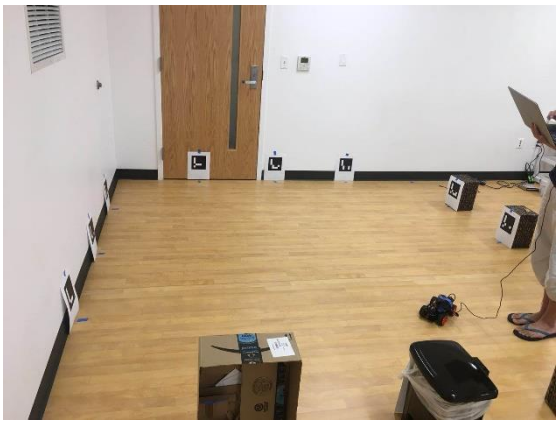
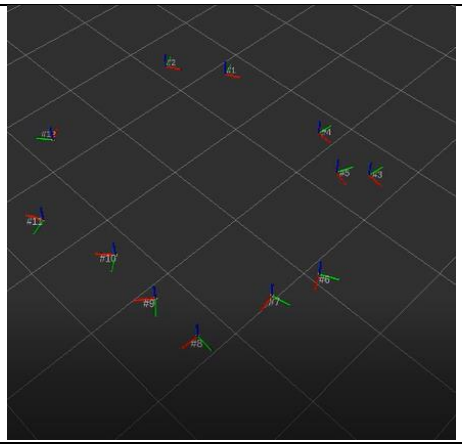
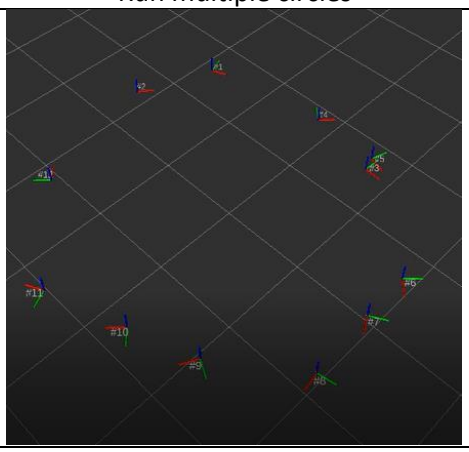
2. Environment (Share with other classmates)
   Using 12 different aruco





3. Result

Run one circle	Run multiple circles
	
In above figure, we can see the distance between #1 and #2 is about 2 meters. In reality, the distance is only 1 meter. Thus, we can know the error is about 1 meter. Besides, the shape of the markers position is like an ellipse in this map instead of an square.	In above figure, the distance between #1 and #2 reduces to 1.5 meters. In addition, we can see there are three markers in each edge, so the shape is like a square. Therefore,I think the error decreases after mutiple circles driving.

4. Code

<HW3.launch>

```
<launch>
  <node name="usb_cam" pkg="usb_cam" type="usb_cam_node" output="screen" >
    <param name="video_device" value="/dev/video0" />
    <param name="image_width" value="800" />
    <param name="image_height" value="450" />
    <param name="pixel_format" value="yuyv" />
    <param name="camera_frame_id" value="usb_cam_frame" />
    <param name="io_method" value="mmap"/>
    <param name="camera_info_url" type="string" value="file://$(find usb_cam)/head_camera_c920.yaml" />
  </node>

  <node pkg="tf" type="static_transform_publisher" name="base_to_odom" args="0 0 0 0 0 0 odom base_link 100" />
  <node pkg="tf" type="static_transform_publisher" name="cam_to_base" args="0 0 0 1.57 0 0 base_link usb_cam_frame 100"/>

  <node name="image_proc" pkg="image_proc" type="image_proc" ns="usb_cam">
    <remap from="image_raw" to="/usb_cam/image_raw"/>
  </node>


  <include file="$(find tuw_aruco)/launch/single_marker_live.launch" />

  <include file="$(find tuw_marker_slam)/launch/slam.launch" />

</launch>
```

<single_marker_live.launch>

```
<launch>

    <node pkg="tuw_aruco" type="aruco_node" name="arMarkerAruco" output="screen">
        <param name="show_debug_image" value="true"/>

        <param name="marker_dictonary" value="ARUCO"/>
        <param name="marker_size" value="0.2"/>

        <param name="publish_tf" value="true"/>
        <param name="publish_markers" value="true"/>
        <param name="publish_fiducials" value="false"/>
        <param name="pose_estimation_enabled" value="true"/>


        <remap from="image" to="/usb_cam/image_raw"/>
        <remap from="camera_info" to="/usb_cam/camera_info"/>

        <remap from="markers" to="/markersAruco"/>
    </node>

</launch>

```

<slam.launch>

```
<launch>
  <!-- Parameters -->
  <arg name="mode" default="0" />
  <arg name="xzplane" default="false" />
  <arg name="frame_id_map" default="map" />
  <arg name="frame_id_odom" default="odom" />
  <arg name="frame_id_base" default="base_link" />
  <arg name="beta_1" default="0.0015108793" />
  <arg name="beta_2" default="0.0030759394" />
  <arg name="beta_3" default="0.0209484956" />
  <arg name="beta_4" default="0.0190882545" />
  <arg name="beta_5" default="-0.0087332785" />
  <arg name="beta_6" default="0.0281445351" />
  <arg name="beta_7" default="0.0200817239" />
  <arg name="beta_8" default="-0.0004093125" />
  <arg name="beta_9" default="0.0085052679" />
  <arg name="beta_10" default="0.0010222184" />
  <arg name="beta_11" default="-0.0007397988" />
  <arg name="beta_12" default="0.0028693465" />
  <arg name="beta_13" default="0.0025763766" />
  <arg name="beta_14" default="0.0721725284" />
  <arg name="beta_15" default="-0.0028335332" />
  <arg name="beta_16" default="0.1056639276" />
  <arg name="beta_17" default="-0.0081272976" />
  <arg name="beta_18" default="0.1105084965" />

  <!-- Remapping -->
  <arg name="marker" default="/markersAruco" />
  <arg name="cmd" default="cmd_vel" />

  <node pkg="tuw_marker_slam" type="tuw_marker_slam_node" name="tuw_marker_slam" output="screen">
      <param name="mode" value="$(arg mode)" />
      <param name="xzplane" value="$(arg xzplane)" />
      <param name="frame_id_map" value="$(arg frame_id_map)" />
      <param name="frame_id_odom" value="$(arg frame_id_odom)" />
      <param name="frame_id_base" value="$(arg frame_id_base)" />
      <param name="beta_1" value="$(arg beta_1)" />
      <param name="beta_2" value="$(arg beta_2)" />
      <param name="beta_3" value="$(arg beta_3)" />
      <param name="beta_4" value="$(arg beta_4)" />
```

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```
41        <param name="beta_5" value="$(arg beta_5)" />
42        <param name="beta_6" value="$(arg beta_6)" />
43        <param name="beta_7" value="$(arg beta_7)" />
44        <param name="beta_8" value="$(arg beta_8)" />
45        <param name="beta_9" value="$(arg beta_9)" />
46        <param name="beta_10" value="$(arg beta_10)" />
47        <param name="beta_11" value="$(arg beta_11)" />
48        <param name="beta_12" value="$(arg beta_12)" />
49        <param name="beta_13" value="$(arg beta_13)" />
50        <param name="beta_14" value="$(arg beta_14)" />
51        <param name="beta_15" value="$(arg beta_15)" />
52        <param name="beta_16" value="$(arg beta_16)" />
53        <param name="beta_17" value="$(arg beta_17)" />
54        <param name="beta_18" value="$(arg beta_18)" />
55        <remap from="marker" to="$(arg marker)" />
56        <remap from="cmd" to="$(arg cmd)" />
57    </node>
58 </launch>
```