Adding Sensors to CATBot

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Laser Scanner Sensor

```
<gazebo reference="laser_scanner">
        <sensor type="ray" name="head_hokuyo_sensor">
                <pose>0 0 0 0 0 0</pose>
                <visualize>true</visualize>
                <update_rate>30.0</update_rate>
                <ray>
                        <scan>
                                <horizontal>
                                        <samples>360</samples>
                                        <resolution>0.5</resolution>
                                        <min_angle>-1.570796</min_angle>
                                        <max_angle> 1.570796</max_angle>
                                </horizontal>
                        </scan>
                        <range>
                                <min>0.10</min>
                                <max>30.0</max>
                                <resolution>0.01</resolution>
                        </range>
                        <noise>
                                <type>gaussian</type>
                                <mean>0.0</mean>
                                <stddev>0.01</stddev>
                        </noise>
                </ray>
                <plugin name="gazebo_ros_head_hokuyo_controller" filename="libgazebo_ros_laser.so">
                        <topicName>/catbot/laser/scan</topicName>
                        <frameName>laser_scanner</frameName>
                </plugin>
        </sensor>
</gazebo>
```

Camera Sensor

```
<gazebo reference = "camera" >
        <sensor type="camera" name = "front_camera">
                <update_rate>30.0</update_rate>
                <camera name="head">
                        <horizontal_fov>1.396</horizontal_fov>
                        <image>
                                <width>860</width>
                                <height>640</height>
                                <format>R8G8B8</format>
                        </image>
                        <clip>
                                <near>0.02</near>
                                <far>300</far>
                        </clip>
                        <noise>
                                <type>gaussian</type>
                                <mean>0.0</mean>
                                <stddev>0.007</stddev>
                        </noise>
                </camera>
                <plugin name="camera_controller" filename="libgazebo_ros_camera.so">
                        <alwaysOn>true</alwaysOn>
                        <updateRate>0.0</updateRate>
                        <cameraName>catbot/front_camera</cameraName>
                        <imageTopicName>image_raw</imageTopicName>
                        <cameraInfoTopicName>camera_info</cameraInfoTopicName>
                        <frameName>camera</frameName>
                        <hackBaseline>0.07</hackBaseline>
                        <distortionK1>0.00</distortionK1>
                        <distortionK2>0.00</distortionK2>
                        <distortionK3>0.00</distortionK3>
                        <distortionT1>0.00</distortionT1>
                        <distortionT2>0.00</distortionT2>
                </plugin>
        </sensor>
</gazebo>
```

IMU Sensor

```
<gazebo>
    <plugin name="imu_controller" filename="libgazebo_ros_imu.so">
        <alwaysOn>true</alwaysOn>
        <updateRate>50.0</updateRate>
        <bodyName>base_footprint</bodyName>
        <topicName>/catbot/imu_data</topicName>
        <gaussianNoise>2.89e-08</gaussianNoise>
        <xyzOffsets>0 0 0</xyzOffsets>
        <rpyOffsets>0 0 0</rpyOffsets>
    </plugin>
</gazebo>
```

Differential Drive Plugin

```
<gazebo>
    <plugin name="differential_drive_controller" filename="libgazebo_ros_diff_drive.so">
        <rosDebugLevel> Debug </rosDebugLevel>
        <publishWheelTF>true</publishWheelTF>
        <robotNameSpace>/</robotNameSpace>
        <publishTF>1</publishTF>
        <publishWheelJointState>true</publishWheelJointState>
        <alwaysOn>true</alwaysOn>
        <updateRate>100.0</updateRate>
        <leftJoint>left_motor</leftJoint>
        <rightJoint>right_motor</rightJoint>
        <wheelSeparation>0.353</wheelSeparation>
        <wheelDiameter>0.164</wheelDiameter>
        <broadcastTF>1</broadcastTF>
        <wheelTorque>30</wheelTorque>
        <wheelAcceleration>2.8</wheelAcceleration>
        <commandTopic>catbot/cmd_vel</commandTopic>
        <odometryFrame>catbot/odom</odometryFrame>
        <odometryTopic>catbot/odom</odometryTopic>
        <robotBaseFrame>base_footprint</robotBaseFrame>
        <legacyMode>false</legacyMode>
        <odometrySource>encoder</odometrySource>
    </plugin>
</gazebo>
```

Rviz: Visualizing Sensors

1) Camera Plugin

2) Laser Scanner

3) IMU

4) Odometry

Exercises

1) Write a node that subscribes to LaserScan data, finds the maximum in the array of LaserScan data and publishes that on a Separate topic as Float64

2) Write a node that subscribes to IMU data, and integrates it with time to get the velocity and position and publishes those on a separate topic as a custom defined message