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Navigating the World with TurtleBot

In the previous chapter, the TurtleBot 2 robot was described as a two-wheeled differential drive robot developed by Willow Garage. The setup of the TurtleBot 2 hardware, netbook, network system, and remote computer were explained, so the user could set up and operate their own TurtleBot. Then, the TurtleBot 2 was driven around using keyboard control, command-line control, and a Python script. TurtleBot 3 was also introduced and driven around using keyboard control.

In this chapter, we will expand TurtleBot's capabilities by giving the robot vision. The chapter begins by describing 3D vision systems and how they are used to map obstacles within the camera's field of view. The four types of 3D sensors typically used for TurtleBot are shown and described, detailing their specifications. A 2D vision system is also introduced for TurtleBot 3.

Setting up the 3D sensor for use on TurtleBot 2 is described and the configuration is tested in a standalone mode. To visualize the sensor data coming from TurtleBot 2, two ROS tools are utilized: Image Viewer and rviz. Then, an important aspect of TurtleBot is described and realized: **navigation**. TurtleBot will be driven around and the vision system will be used to build a map of the environment. The map is loaded into rviz and used to give the user point and click control of TurtleBot so that it can autonomously navigate to a location selected on the map. Two additional navigation methods will be shown: driving TurtleBot to a location without a map and driving with a map and a Python script. The autonomous navigation ability using rviz is also shown for TurtleBot 3.

In this chapter, you will learn the following topics:

- How 3D vision sensors work
- The difference between the four primary 3D sensors for TurtleBot
- Details on a 2D vision system for TurtleBot 3
- Information on TurtleBot environmental variables and the ROS software required for the sensors
- ROS tools for the rgb and depth camera output
- How to use TurtleBot to map a room using **Simultaneous Localization and Mapping (SLAM)**
- How to operate TurtleBot in autonomous navigation mode by **adaptive monte carlo localization (amcl)**
- How to navigate TurtleBot to a location without a map
- How to navigate TurtleBot to waypoints with a Python script and a map