TurtleBot4 Cube Seeker Setup & Execution

# 1. Base System Setup

1. Update package lists and install essential tools:  
```bash  
sudo apt update  
sudo apt install -y build-essential python3-colcon-common-extensions python3-pip python3-vcstool git  
```  
  
2. Install ROS 2 Humble Desktop:  
```bash  
sudo apt install -y ros-humble-desktop  
echo 'source /opt/ros/humble/setup.bash' >> ~/.bashrc  
source ~/.bashrc  
```

# 2. TurtleBot4 Bringup & Navigation

Install the TB4 hardware drivers, SLAM, and Nav2 stacks:  
```bash  
sudo apt install -y ros-humble-turtlebot4-bringup ros-humble-turtlebot4-navigation2 ros-humble-nav2-bringup ros-humble-navigation2 ros-humble-slam-toolbox  
```

# 3. Tutorial Helper & Vision Support

Install the official tutorial package (includes TurtleBot4Navigator helper) and OpenCV bridge:  
```bash  
sudo apt install -y ros-humble-turtlebot4-tutorials ros-humble-cv-bridge ros-humble-image-transport python3-opencv  
```

# 4. (Optional) Gazebo Simulation

To test in simulation before deploying on hardware:  
```bash  
sudo apt install -y ros-humble-turtlebot4-gazebo ros-humble-turtlebot4-simulations  
```

# 5. Workspace Setup & Build

1. Navigate to your ROS 2 workspace:  
```bash  
cd ~/ros2\_ws  
```  
  
2. Install any missing dependencies via rosdep:  
```bash  
rosdep install --from-paths src --ignore-src -r -y  
```  
  
3. Build your package (e.g., tb4\_nav\_cube):  
```bash  
colcon build --packages-select tb4\_nav\_cube  
source install/setup.bash  
```

# 6. Launch Bringup & Run Node

1. Launch SLAM + Nav2 along with the robot drivers:  
 - \*\*Real hardware\*\*:  
 ```bash  
 ros2 launch turtlebot4\_bringup robot.launch.py slam:=True use\_sim\_time:=False  
 ```  
 - \*\*Gazebo simulation\*\*:  
 ```bash  
 ros2 launch turtlebot4\_gazebo turtlebot4\_world.launch.py  
 ros2 launch turtlebot4\_bringup robot.launch.py slam:=True use\_sim\_time:=True  
 ```  
  
2. In a separate terminal, run the cube seeker node:  
```bash  
ros2 run tb4\_nav\_cube nav\_to\_cube  
```

# 7. Code Execution Steps

Ensure your node script is executable and entry point is defined in setup.py:  
```bash  
cd ~/ros2\_ws/src/tb4\_nav\_cube/tb4\_nav\_cube  
chmod +x nav\_to\_cube.py  
```  
  
Verify setup.py contains:  
```python  
entry\_points={  
 'console\_scripts': [  
 'nav\_to\_cube = tb4\_nav\_cube.nav\_to\_cube:main',  
 ],  
},  
```  
Then rebuild and re-source as shown above.

# Summary

You now have a complete setup to build the workspace, launch SLAM/Nav2, and run the enhanced cube seeker node on TurtleBot 4, whether on hardware or in Gazebo.