轮 趣 科 技

ROS2 机器人源码编译教程

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版本说明：

版本	日期	内容说明
V1.0	2023/06/07	第一次发布

网址：www.wheeltec.net

序言

本文档旨在帮助大家在不购买 WHEELTEC 整车的情况下，也能使用 WHEELTEC 的源码实现 ROS2 机器人导航。文档基本把实现导航需要的全部依赖进行了说明，并提供了解决方案。

同时希望各位同学保持独立思考的习惯，很多问题都可以通过搜索引擎进行查找解决，例如编译报了 xxx 红色错误，一般搜索该 xxx 内容就可以看到解决方案。

Linux、Python、C++、ROS、STM32 等基础知识，在 B 站上也有大量优秀视频教程.

1. 编译过程

1. 1新建一个工作空间【wheeltec_ros2】

新建一个工作空间【wheeltec_ros2】，将源码 SRC 文件拷贝至 wheeltec_ros2 工作空间中。

1. 2运行 rosdep update

在系统环境中运行 rosdep init 后，运行 rosdep update。

```
wheeltec@galactic:~$ sudo rosdep init
Wrote /etc/ros/rosdep/sources.list.d/20-default.list
Recommended: please run

        rosdep update

wheeltec@galactic:~$ /etc/ros/rosdep/sources.list.d/20-default.list^C
wheeltec@galactic:~$ rosdep update
reading in sources list data from /etc/ros/rosdep/sources.list.d
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/osx-homebrew.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/base.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/python.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/ruby.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/releases/fuerte.yaml
Query rosdistro index https://raw.githubusercontent.com/ros/rosdistro/master/index-v4.yaml
Skip end-of-life distro "ardent"
Skip end-of-life distro "bouncy"
Skip end-of-life distro "crystal"
Skip end-of-life distro "dashing"
Skip end-of-life distro "eloquent"
Add distro "foxy"
Skip end-of-life distro "galactic"
Skip end-of-life distro "groovy"
Add distro "humble"
Skip end-of-life distro "hydro"
Skip end-of-life distro "indigo"
Add distro "iron"
Skip end-of-life distro "jade"
Skip end-of-life distro "kinetic"
Skip end-of-life distro "lunar"
Add distro "melodic"
Add distro "noetic"
Add distro "rolling"
updated cache in /home/wheeltec/.ros/rosdep/sources.cache
wheeltec@galactic:~$
```

使用一键安装依赖指令，在工作空间文件夹路径下运行 rosdep 的一键安装依赖命令。注意工作空间文件夹不是 src 文件夹。在工作空间下运行以下命令可以安装绝大部分功能包依赖：

```
rosdep install --from-paths src --ignore-src -r -y
或
rosdep install --from-paths src --ignore-src -r -y --rosdistro galactic
```

```
wheeltec@galactic:~$ cd wheeltec_ros2/
wheeltec@galactic:~/wheeltec_ros2$ ls
src
wheeltec@galactic:~/wheeltec_ros2$ rosdep install --from-paths src --ignore-src -r -y --rosdistro galactic
ERROR: the following packages/stacks could not have their rosdep keys resolved
to system dependencies:
web_video_server: Cannot locate rosdep definition for [async_web_server_cpp]
nav2_smac_planner: Cannot locate rosdep definition for [ompl]
nav2_bt_navigator: Cannot locate rosdep definition for [behaviortree_cpp_v3]
nav2_behavior_tree: Cannot locate rosdep definition for [behaviortree_cpp_v3]
nav2_util: Cannot locate rosdep definition for [test_msgs]
nav2_system_tests: Cannot locate rosdep definition for [gazebo_ros_pkgs]
lslidar_driver: Cannot locate rosdep definition for [diagnostic_updater]
usb_cam: Cannot locate rosdep definition for [image_transport_plugins]
Continuing to install resolvable dependencies...
executing command [sudo -H apt-get install -y ffmpeg]
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
建议安装：
  ffmpeg-doc
下列【新】软件包将被安装：
  ffmpeg
升级了 0 个软件包，新安装了 1 个软件包，要卸载 0 个软件包，有 982 个软件包未被升级。
需要下载 1,453 kB 的归档。
解压缩后会消耗 2,063 kB 的额外空间。
0% [正在连接 mirrors.aliyun.com]
```

运行完成后会显示#all required rosdeps installed successfully

```
解压缩后会消耗 2,274 kB 的额外空间。
获取:1 http://mirrors.aliyun.com/ubuntu focal/main amd64 libv4l2rds0 amd64 1.18.0-2build1 [15.8 kB]
获取:2 http://mirrors.aliyun.com/ubuntu focal/universe amd64 v4l-utils amd64 1.18.0-2build1 [586 kB]
已下载 602 kB，耗时 10秒 (57.5 kB/s)
正在选中未选择的软件包 libv4l2rds0:amd64。
(正在读取数据库 ... 系统当前共安装有 274349 个文件和目录。)
准备解压 .../libv4l2rds0_1.18.0-2build1_amd64.deb  ...
正在解压 libv4l2rds0:amd64 (1.18.0-2build1) ...
正在选中未选择的软件包 v4l-utils。
准备解压 .../v4l-utils_1.18.0-2build1_amd64.deb  ...
正在解压 v4l-utils (1.18.0-2build1) ...
正在设置 libv4l2rds0:amd64 (1.18.0-2build1) ...
正在设置 v4l-utils (1.18.0-2build1) ...
正在处理用于 libc-bin (2.31-0ubuntu9.9) 的触发器 ...
正在处理用于 man-db (2.9.1-1) 的触发器 ...
#All required rosdeps installed successfully
wheeltec@galactic:~/wheeltec_ros2$
```

1.3关于二进制安装的功能包

在 wheeltec_ros2 中，二进制安装的功能包有：

usb_cam-ros2：在 ROS 中使用 UVC 协议的相机功能包

```
sudo apt install ros-galactic-usb-cam
```

web_video_server-ros2：网络视频服务器，在 ROS 中启动相机，运行网络视频服务器后可以在浏览器中查看相机实时图像。

```
sudo apt install ros-galactic-async-web-server-cpp*
```

wheeltec_robot_rtab:RTAB 算法建图，可获取 3D 视觉点云

```
sudo apt install ros-galactic-rtab*
```

wheeltec_cartographer:cartographer 算法建图

```
sudo apt install ros-galactic-cartographer*
```

wheeltec_slam_toolbox:slam_toolbox 算法建图

```
sudo apt install ros-galactic-slam-toolbox*
```

1.4编译以及报错解决

主要是安装一些 rosdep 遗漏的依赖，如果是拷贝了整个 wheeltec_ros2/src 源码，则需要安装以下依赖：

```
sudo apt install ros-galactic-test-msgs* -y
sudo apt install ros-galactic-behaviortree-cpp-v3* -y
sudo apt install ros-galactic-ompl -y
sudo apt install ros-galactic-async-web-server-cpp* -y
sudo apt install ros-galactic-filters -y
sudo apt install ros-galactic-diagnostic-updater
sudo apt install ros-galactic-gazebo-ros-pkgs -y
```

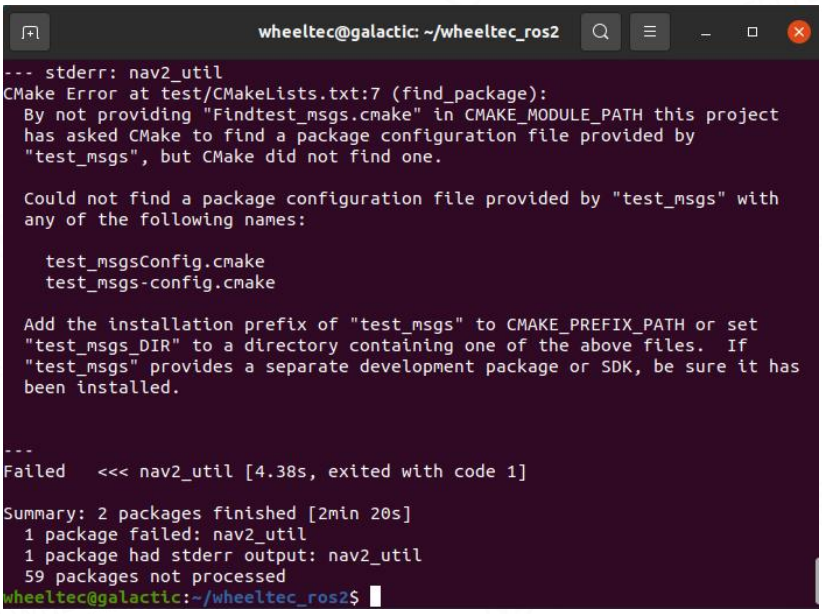
若使用某个功能包出现报错，可以根据下面的解决方法进行编译。

在工作空间目录下运行编译指令：

```
cd ~/wheeltec_ros2
colcon build
```

出现报错：

```
Could not find a package configuration file provided by "test_msgs" with
any of the following names:
```



解决办法，安装 test-msgs 依赖：

```
sudo apt install ros-galactic-test-msgs*
```

```
wheeltec@galactic:~/wheeltec_ros2$ sudo apt install ros-galactic-test-msgs*
[sudo] password for wheeltec:
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
注意，根据Glob 'ros-galactic-test-msgs*' 选中了 'ros-galactic-test-msgs-dbgsym'
注意，根据Glob 'ros-galactic-test-msgs*' 选中了 'ros-galactic-test-msgs'
下列【新】软件包将被安装：
  ros-galactic-test-msgs ros-galactic-test-msgs-dbgsym
升级了 0 个软件包，新安装了 2 个软件包，要卸载 0 个软件包，有 982 个软件包未被升级。
需要下载 4,446 kB 的归档。
解压缩后会消耗 9,931 kB 的额外空间。
获取:1 http://packages.ros.org/ros2/ubuntu focal/main amd64 ros-galactic-test-msgs amd64 1.0.3-2focal.20221203.094942 [347 kB]
获取:2 http://packages.ros.org/ros2/ubuntu focal/main amd64 ros-galactic-test-msgs-dbgsym amd64 1.0.3-2focal.20221203.094942 [4,100 kB]
24% [2 ros-galactic-test-msgs-dbgsym 415 kB/4,100 kB 10%]    82.3 kB/s 44秒
```

安装完成后，继续编译：

```
colcon build
```

出现错误：

```
Could not find a package configuration file provided by
  "behaviortree_cpp_v3" with any of the following names:
```

```
wheeltec@galactic: ~/wheeltec_ros2
--- stderr: nav2_behavior_tree
CMake Error at CMakeLists.txt:14 (find_package):
  By not providing "Findbehaviortree_cpp_v3.cmake" in CMAKE_MODULE_PATH this
  project has asked CMake to find a package configuration file provided by
  "behaviortree_cpp_v3", but CMake did not find one.

  Could not find a package configuration file provided by
  "behaviortree_cpp_v3" with any of the following names:

    behaviortree_cpp_v3Config.cmake
    behaviortree_cpp_v3-config.cmake

  Add the installation prefix of "behaviortree_cpp_v3" to CMAKE_PREFIX_PATH
  or set "behaviortree_cpp_v3_DIR" to a directory containing one of the above
  files.  If "behaviortree_cpp_v3" provides a separate development package or
  SDK, be sure it has been installed.


---
Failed   <<< nav2_behavior_tree [2.00s, exited with code 1]

Summary: 7 packages finished [4min 30s]
  1 package failed: nav2_behavior_tree
  1 package had stderr output: nav2_behavior_tree
  54 packages not processed
wheeltec@galactic:~/wheeltec_ros2$
```

解决方法，安装 behaviortree-cpp-v3 依赖：

```
sudo apt install ros-galactic-behaviortree-cpp-v3*
```

```
wheeltec@galactic:~/wheeltec_ros2$ sudo apt install ros-galactic-behaviortree-cpp-v3* -y
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
注意，根据Glob 'ros-galactic-behaviortree-cpp-v3*' 选中了 'ros-galactic-behaviortree-cpp-v3-dbgsym'
注意，根据Glob 'ros-galactic-behaviortree-cpp-v3*' 选中了 'ros-galactic-behaviortree-cpp-v3'
将会同时安装下列软件：
  libncurses-dev libncurses5-dev libncursesw6 libtinfo6
建议安装：
  ncurses-doc
下列【新】软件包将被安装：
  libncurses-dev libncurses5-dev ros-galactic-behaviortree-cpp-v3
  ros-galactic-behaviortree-cpp-v3-dbgsym
下列软件包将被升级：
  libncurses6 libncursesw6 libtinfo6
升级了 3 个软件包，新安装了 4 个软件包，要卸载 0 个软件包，有 979 个软件包未被升级。
需要下载 7,305 kB 的归档。
解压缩后会消耗 10.5 MB 的额外空间。
获取:1 http://mirrors.aliyun.com/ubuntu focal-security/main amd64 libncursesw6 amd64 6.2-0ubuntu2.1 [132 kB]
获取:2 http://mirrors.aliyun.com/ubuntu focal-security/main amd64 libncurses6
```

安装完成后继续编译，出现报错：

```
Could not find a package configuration file provided by "ompl" with any of
  the following names:
```

```
--- stderr: nav2_smac_planner
CMake Error at CMakeLists.txt:24 (find_package):
  By not providing "Findompl.cmake" in CMAKE_MODULE_PATH this project has
  asked CMake to find a package configuration file provided by "ompl", but
  CMake did not find one.

  Could not find a package configuration file provided by "ompl" with any of
  the following names:

    omplConfig.cmake
    ompl-config.cmake

  Add the installation prefix of "ompl" to CMAKE_PREFIX_PATH or set
  "ompl_DIR" to a directory containing one of the above files.  If "ompl"
  provides a separate development package or SDK, be sure it has been
  installed.


---
Failed   <<< nav2_smac_planner [4.19s, exited with code 1]

Summary: 24 packages finished [33min 29s]
  1 package failed: nav2_smac_planner
  1 package had stderr output: nav2_smac_planner
  37 packages not processed
wheeltec@galactic:~/wheeltec_ros2$
```

解决方法：安装 ompl 依赖

```
sudo apt install ros-galactic-ompl -y
```

```
wheeltec@galactic:~/wheeltec_ros2$ sudo apt install ros-galactic-ompl -y
[sudo] password for wheeltec:
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
下列【新】软件包将被安装：
  ros-galactic-ompl
升级了 0 个软件包，新安装了 1 个软件包，要卸载 0 个软件包，有 979 个软件包未被升级。
需要下载 1,776 kB 的归档。
解压缩后会消耗 10.3 MB 的额外空间。
获取:1 http://packages.ros.org/ros2/ubuntu focal/main amd64 ros-galactic-ompl amd64 1.5.2-1focal.20221203.081504 [1,776 kB]
37% [1 ros-galactic-ompl 825 kB/1,776 kB 46%]
```

安装完成后继续编译，出现报错：

```
project has asked CMake to find a package configuration file provided by
  "async_web_server_cpp", but CMake did not find one
```

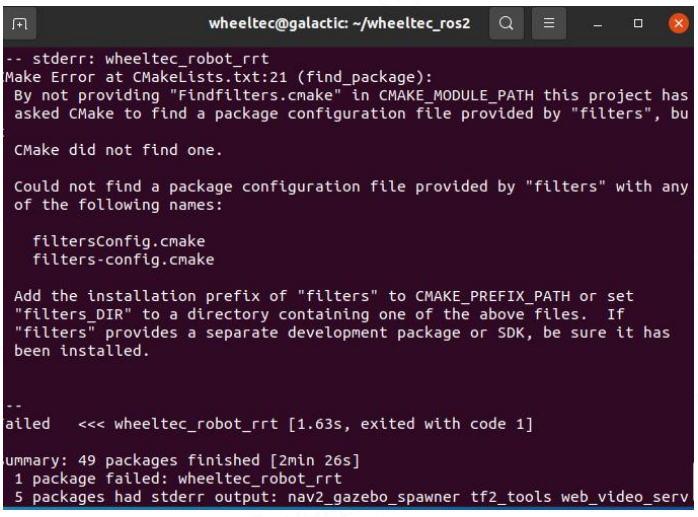
```
Starting >>> web_video_server
--- stderr: web_video_server
CMake Error at CMakeLists.txt:6 (find_package):
  By not providing "Findasync_web_server_cpp.cmake" in CMAKE_MODULE_PATH thi
s
  project has asked CMake to find a package configuration file provided by
  "async_web_server_cpp", but CMake did not find one.

  Could not find a package configuration file provided by
  "async_web_server_cpp" with any of the following names:

    async_web_server_cppConfig.cmake
    async_web_server_cpp-config.cmake

  Add the installation prefix of "async_web_server_cpp" to CMAKE_PREFIX_PATH
  or set "async_web_server_cpp_DIR" to a directory containing one of the
  above files.  If "async_web_server_cpp" provides a separate development
  package or SDK, be sure it has been installed.


---
Failed   <<< web_video_server [0.72s, exited with code 1]

Summary: 45 packages finished [10min 53s]
  1 package failed: web_video_server
```

解决办法：

```
sudo apt install ros-galactic-async-web-server-cpp* -y
```

安装完成后继续编译，出现报错：

```
Could not find a package configuration file provided by "filters" with any
  of the following names:
```

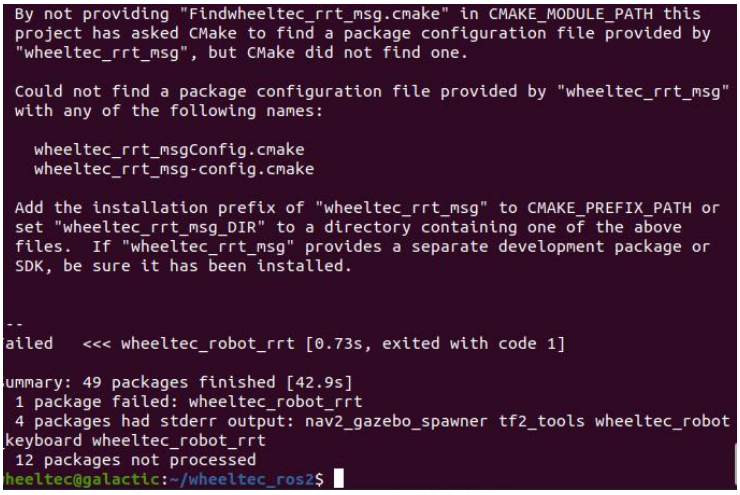


解决办法：安装 filters 依赖

```
sudo apt install ros-galactic-filters -y
```

继续编译，出现报错：

```
Could not find a package configuration file provided by "wheeltec_rrt_msg"
  with any of the following names:
```

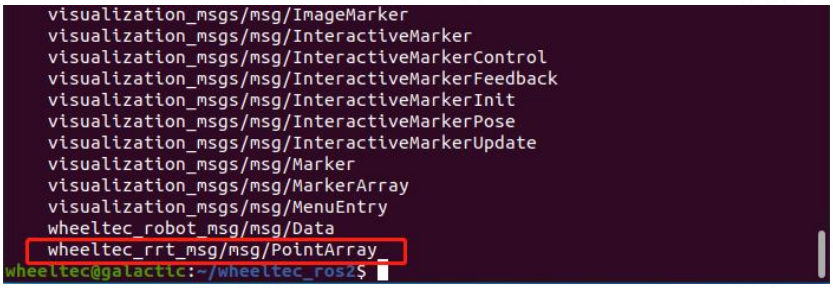


解决办法：

单独编译 wheeltec_rrt_msg 功能包，使系统获得自定义的 msg

```
colcon build --packages-select wheeltec_rrt_msg
```

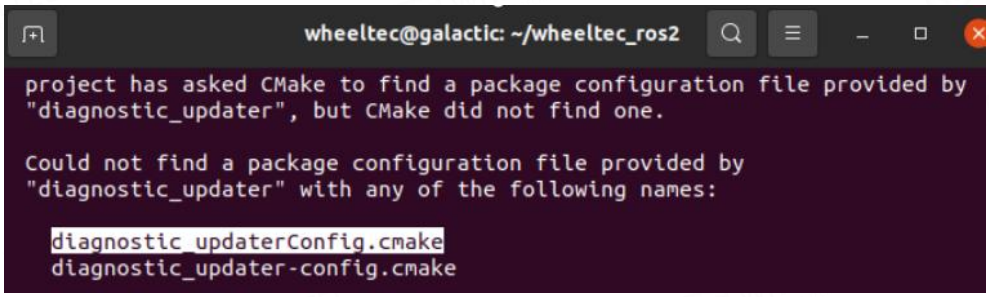
编译完成从后运行 source install/setup.bash，使工作空间的环境变量生效，使用 ros2 interface list -m 命令可以查看到 wheeltec_rrt_msg 的内容：



继续编译功能包：

出现报错：

```
  Could not find a package configuration file provided by
  "diagnostic_updater" with any of the following names:
```



解决办法：安装 diagnostic-updater 依赖

```
sudo apt install ros-galactic-diagnostic-updater
```

```
wheeltec@galactic:~/wheeltec_ros2$ sudo apt-get install ros-galactic-diagnostic-up
dater
[sudo] password for wheeltec:
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
下列【新】软件包将被安装：
  ros-galactic-diagnostic-updater
升级了 0 个软件包，新安装了 1 个软件包，要卸载 0 个软件包，有 974 个软件包未被升级
。
需要下载 91.6 kB 的归档。
解压缩后会消耗 408 kB 的额外空间。
获取:1 http://packages.ros.org/ros2/ubuntu focal/main amd64 ros-galactic-diagnosti
c-updater amd64 2.1.3-1focal.20221207.073007 [91.6 kB]
已下载 91.6 kB，耗时 2秒 (54.8 kB/s)
正在选中未选择的软件包 ros-galactic-diagnostic-updater。
(正在读取数据库 ... 系统当前共安装有 276400 个文件和目录。)
准备解压 .../ros-galactic-diagnostic-updater_2.1.3-1focal.20221207.073007_amd64.de
b  ...
正在解压 ros-galactic-diagnostic-updater (2.1.3-1focal.20221207.073007) ...
正在设置 ros-galactic-diagnostic-updater (2.1.3-1focal.20221207.073007) ...
```

继续编译功能包：

出现报错：

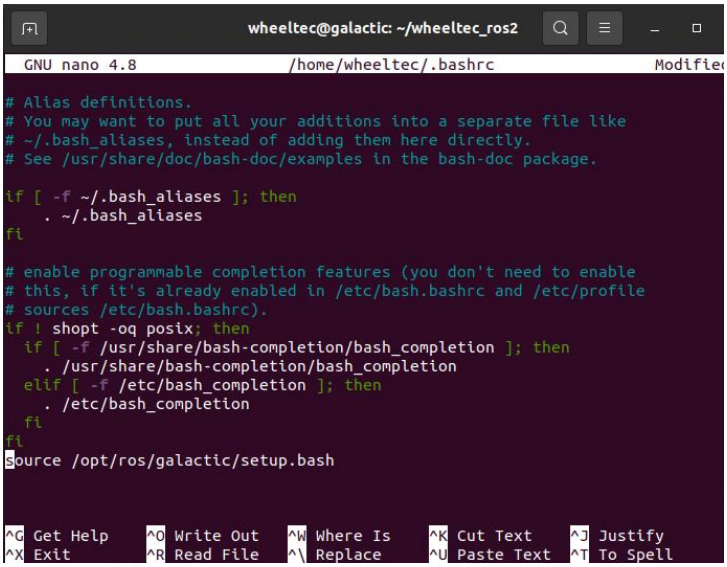
```
ModuleNotFoundError: No module named 'ament_package'
```

```
wheeltec@galactic: ~/wheeltec_ros2
Finished <<< wheeltec_slam_toolbox [0.28s]
Starting >>> astra_camera
Finished <<< astra_camera [0.90s]
Starting >>> lslidar_driver
--- stderr: lslidar_driver
Traceback (most recent call last):
  File "/opt/ros/galactic/share/ament_cmake_core/cmake/package_templates/templates
_2_cmake.py", line 21, in <module>
    from ament_package.templates import get_environment_hook_template_path
ModuleNotFoundError: No module named 'ament_package'
CMake Error at /opt/ros/galactic/share/ament_cmake_core/cmake/ament_cmake_package_
templates-extras.cmake:41 (message):
  execute_process(/usr/bin/python3
  /opt/ros/galactic/share/ament_cmake_core/cmake/package_templates/templates_2_cma
ke.py
  /home/wheeltec/wheeltec_ros2/build/lslidar_driver/ament_cmake_package_templates/
templates.cmake)
  returned error code 1
Call Stack (most recent call first):
  /opt/ros/galactic/share/ament_cmake_core/cmake/ament_cmake_coreConfig.cmake:41 (
include)
  /opt/ros/galactic/share/rclcpp/cmake/ament_cmake_export_include_directories-extr
as.cmake:8 (find_package)
  /opt/ros/galactic/share/rclcpp/cmake/rclcppConfig.cmake:41 (include)
  CMakeLists.txt:20 (find_package)
```

解决办法：这里的报错是因为系统没有识别到 galactic 环境，需要 source 一遍环境变量，运行以下指令：

```
source /opt/ros/galactic/setup.bash
```

或在 ~/.bashrc 文件中增加一句：‘source /opt/ros/galactic/setup.bash’

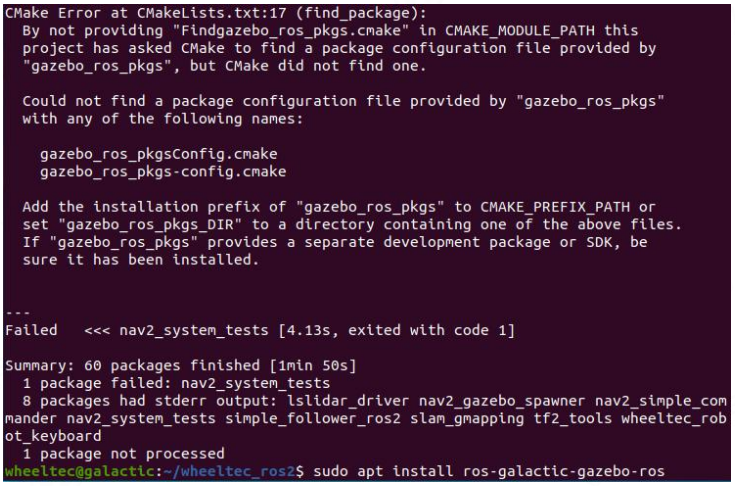


增加后在终端输入：source ~/.bashrc 即可

继续编译功能包：

出现报错：

```
Could not find a package configuration file provided by "gazebo_ros_pkgs"
 with any of the following names:
```

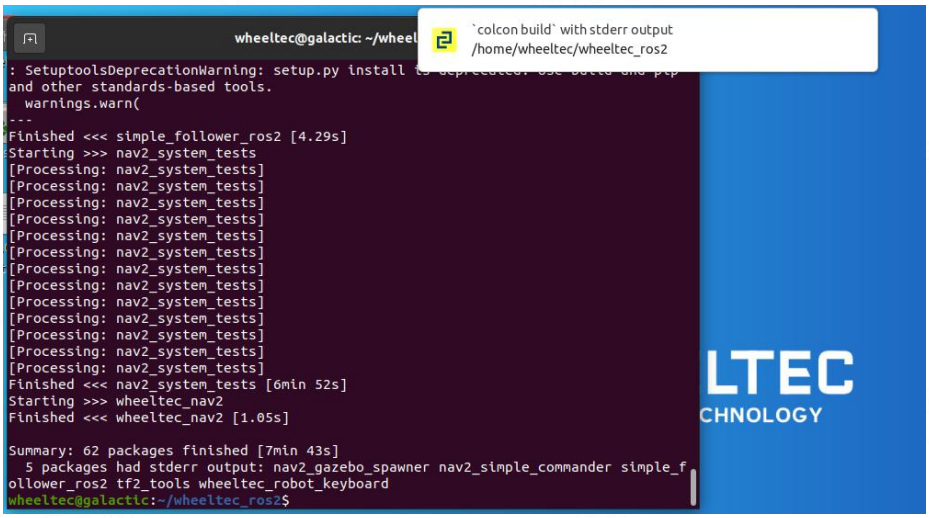


解决方法：安装 gazebo-ros-pkgs 依赖

```
sudo apt install ros-gazebo-ros-pkgs -y
```

```
wheeltec@galactic:~/wheeltec_ros2$ sudo apt install ros-galactic-gazebo-ros-pkgs -
y
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
将会同时安装下列软件：
  gazebo11 gazebo11-plugin-base libgazebo11 libgazebo11-dev
  libignition-cmake2-dev libignition-math6 libignition-math6-dev libsdformat9
  libsdformat9-dev ros-galactic-gazebo-dev ros-galactic-gazebo-plugins
  ros-galactic-gazebo-ros sdformat9-sdf
建议安装：
  gazebo11-doc
下列【新】软件包将被安装：
  ros-galactic-gazebo-dev ros-galactic-gazebo-plugins ros-galactic-gazebo-ros
  ros-galactic-gazebo-ros-pkgs
下列软件包将被升级：
  gazebo11 gazebo11-plugin-base libgazebo11 libgazebo11-dev
  libignition-cmake2-dev libignition-math6 libignition-math6-dev libsdformat9
  libsdformat9-dev sdformat9-sdf
升级了 10 个软件包，新安装了 4 个软件包，要卸载 0 个软件包，有 964 个软件包未被升
级。
需要下载 18.5 MB 的归档。
解压缩后会消耗 17.7 MB 的额外空间。
0% [执行中]
```

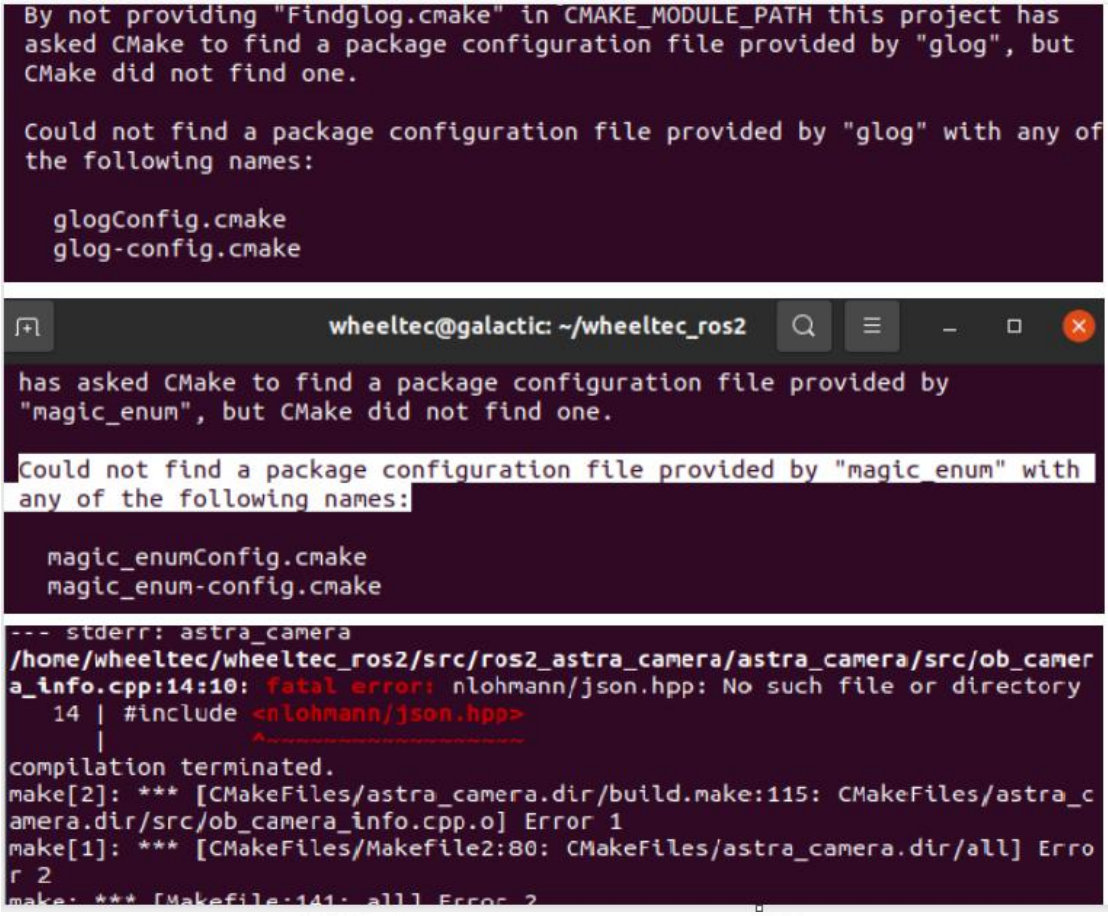
继续编译功能包，编译完成，如图所示：



1.5Astra 相机相关依赖

若编译前没有安装 astra 奥比相机功能包相关的依赖，则会出现以下类型报错：

```
    报错 1: Could not find a package configuration file provided by "glog" with any
of the following names:
    报错 2: Could not find a package configuration file provided by "magic_enum"
with any of the following names:
    报错 3:
/home/wheeltec/wheeltec_ros2/src/ros2_astra_camera/astra_camera/src/ob_camera_i
nfo.cpp:14:10: fatal error: nlohmann/json.hpp: No such file or directory
      14 | #include <nlohmann/json.hpp>
```



所以编译奥比相机 SDK 前需要先安装依赖：

step1:

```
sudo apt install libgflags-dev nlohmann-json3-dev \
ros-galactic-image-transport ros-galactic-image-publisher
```

step2:安装 glog 依赖

```
cd ~
wget -c https://github.com/google/glog/archive/refs/tags/v0.6.0.tar.gz  -O
glog-0.6.0.tar.gz
tar -xzvf glog-0.6.0.tar.gz
cd glog-0.6.0
mkdir build && cd build
cmake .. && make -j4
sudo make install
sudo ldconfig
```

step3:安装 magic_enum 依赖

```
cd ~
wget -c
https://github.com/Neargye/magic_enum/archive/refs/tags/v0.8.0.tar.gz -O
magic_enum-0.8.0.tar.gz
tar -xzvf magic_enum-0.8.0.tar.gz
```

```
cd magic_enum-0.8.0
mkdir build && cd build
cmake .. && make -j4
sudo make install
sudo ldconfig # Refreshing the link library
```

step4: 安装 libuvc 依赖

```
git clone https://github.com/libuvc/libuvc.git
cd libuvc
mkdir build && cd build
cmake .. && make -j4
sudo make install
sudo ldconfig # Refreshing the link library
```

step5:

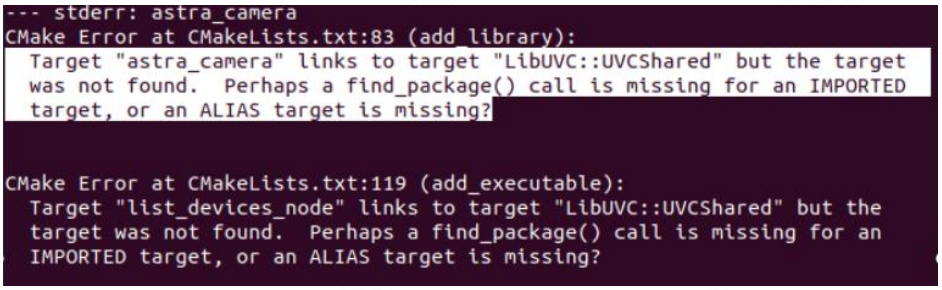
```
cd ~/wheeltec_ros2/src/ros2_astra_camera/astra_camera/scripts
sudo bash install.sh
sudo udevadm control --reload-rules && sudo udevadm trigger
```

step6 :编译相机 SDK

```
cd ~/wheeltec_ws
source /opt/ros/galactic/setup.bash
colcon build --packages-select astra_camera_msgs
colcon build --packages-select astra_camera
```

出现报错：

```
Target "astra_camera" links to target "LibUVC::UVCShared" but the target
  was not found.  Perhaps a find_package() call is missing for an IMPORTED
  target, or an ALIAS target is missing?
```



解决办法，修改 ros2_astra_camera/astra_camera 文件夹下的 CMakeLists.txt，将 LibUVC::UVCShared 修改为${libuvc_LIBRARIES}，保存后编译即可。


Open
CMakeLists.txt
~/wheeltec_ros2/src/ros2_astra_camera/astra_camera
Save
)
target_link_libraries(list_devices_node
${OpenCV_LIBS}
Eigen3::Eigen
glog::glog
magic_enum::magic_enum
#LibUVC::UVCShared
${libuvc_LIBRARIES}
-lOpenNI2
-L${ORBBEC_OPENNI2_REDIST}
${PROJECT_NAME}
)
target_compile_definitions(${PROJECT_NAME} PRIVATE "COMPOSITION_BUILDING_DLL")
rclcpp_components_register_nodes(${PROJECT_NAME}
"${PROJECT_NAME}::PointCloudXyzrgbNode"
"${PROJECT_NAME}::PointCloudXyzNode"
"${PROJECT_NAME}::OBCameraNodeFactory")
install(TARGETS ${PROJECT_NAME}
ARCHIVE DESTINATION lib
LIBRARY DESTINATION lib
RUNTIME DESTINATION bin
)
Saving file "/home/wheeltec/wheeltec_ros2/src/ro...
CMake
Tab Width: 8
Ln 143, Col 1
INS