Release speed topic

1. Experimental Purpose

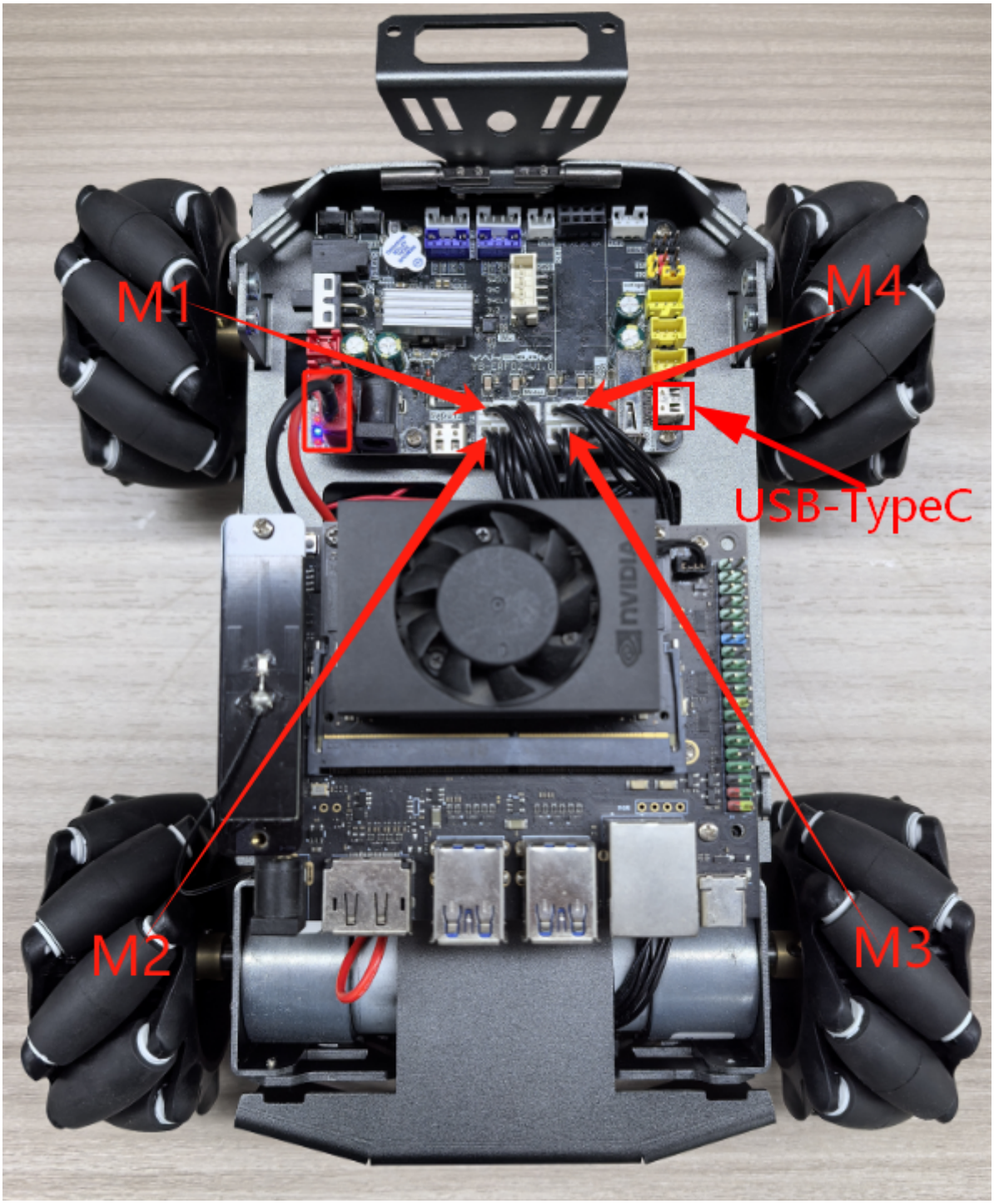
Learn about STM32-microROS components, access the ROS2 environment, and publish a topic on the robot car's odom speed.

2. Hardware Connection

As shown in the figure below, the STM32 control board integrates four encoder motor drivers and interfaces, connecting the four motors to the motor interfaces. The corresponding names of the four motor interfaces are: left front wheel -> M1, left rear wheel -> M2, right front wheel -> M3, and right rear wheel -> M4.

Since the encoder motor requires high voltage and high current, it must be powered by a battery.

Use a Type-C data cable to connect the USB port of the main control board and the USB Connect port of the STM32 control board.



Note: There are many types of main control boards. Here we take the Jetson Orin series main control board as an example, with the default factory image burned.

3. Core code analysis

The virtual machine path corresponding to the program source code is:

```
Board_Samples/Microros_Samples/Publisher_odom
```

Create the publisher "odom_raw" and specify the publisher's information type as nav_msgs/msg/Odometry.

```
RCCHECK(rclc_publisher_init_default(
        &odom_publisher,
        &node,
        ROSIDL_GET_MSG_TYPE_SUPPORT(nav_msgs, msg, Odometry),
        "odom_raw"));
```

Create a publisher timer with a publishing frequency of 11HZ.

```
#define ODOM_PUBLISHER_TIMEOUT (50)
RCCHECK(rclc_timer_init_default(
        &odom_publisher_timer,
        &support,
        RCL_MS_TO_NS(ODOM_PUBLISHER_TIMEOUT),
        odom_publisher_callback));
```

Adds the publisher's timer to the executor.

```
RCCHECK(rclc_executor_add_timer(&executor, &odom_publisher_timer));
```

The main function of the odom timer callback function is to update the odom data and send the data out.

```
void odom_publisher_callback(rcl_timer_t *timer, int64_t last_call_time)
{
    RCLC_UNUSED(last_call_time);
    if (timer != NULL)
    {
        publish_odom_data();
    }
}
void publish_odom_data()
{
    timespec_t time_stamp = get_ros2_timestamp();
    int64_t now = get_millisecond();
    float vel_dt = (now - prev_odom_update) / 1000.0;
    prev_odom_update = now;

    odom_update(
        vel_dt,
        car_data.v_x,
        car_data.v_y,
        car_data.v_z);
    odom_msg.header.stamp.sec = time_stamp.tv_sec;
    odom_msg.header.stamp.nanosec = time_stamp.tv_nsec;
    RCSOFTCHECK(rcl_publish(&odom_publisher, &odom_msg, NULL));
}
```

Read the speed from the robot car and update the odom information according to the car speed.

```
void odom_update(float vel_dt, float linear_vel_x, float linear_vel_y, float
angular_vel_z)
{
    float delta_heading = angular_vel_z * vel_dt; // radians
    float cos_h = cos(heading_);
```

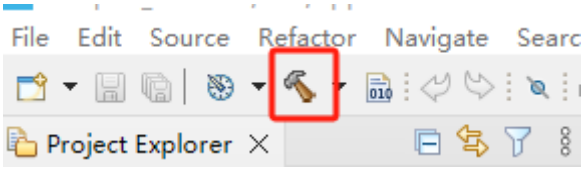
```
    float sin_h = sin(heading_);
    float delta_x = (linear_vel_x * cos_h - linear_vel_y * sin_h) * vel_dt; // m
    float delta_y = (linear_vel_x * sin_h + linear_vel_y * cos_h) * vel_dt; // m

    // calculate current position of the robot
    x_pos_ += delta_x;
    y_pos_ += delta_y;
    heading_ += delta_heading;

    // calculate robot's heading in quaternion angle
    // ROS has a function to calculate yaw in quaternion angle
    float q[4];
    odom_euler_to_quat(0, 0, heading_, q);

    // robot's position in x,y, and z
    odom_msg.pose.pose.position.x = x_pos_;
    odom_msg.pose.pose.position.y = y_pos_;
    odom_msg.pose.pose.position.z = 0.0;

    // robot's heading in quaternion
    odom_msg.pose.pose.orientation.x = (double)q[1];
    odom_msg.pose.pose.orientation.y = (double)q[2];
    odom_msg.pose.pose.orientation.z = (double)q[3];
    odom_msg.pose.pose.orientation.w = (double)q[0];

    odom_msg.pose.covariance[0] = 0.001;
    odom_msg.pose.covariance[7] = 0.001;
    odom_msg.pose.covariance[35] = 0.001;

    // linear speed from encoders
    odom_msg.twist.twist.linear.x = linear_vel_x;
    odom_msg.twist.twist.linear.y = linear_vel_y;
    odom_msg.twist.twist.linear.z = 0.0;

    // angular speed from encoders
    odom_msg.twist.twist.angular.x = 0.0;
    odom_msg.twist.twist.angular.y = 0.0;
    odom_msg.twist.twist.angular.z = angular_vel_z;

    odom_msg.twist.covariance[0] = 0.0001;
    odom_msg.twist.covariance[7] = 0.0001;
    odom_msg.twist.covariance[35] = 0.0001;
}
```

Call rclc_executor_spin_some in a loop to make microros work properly.

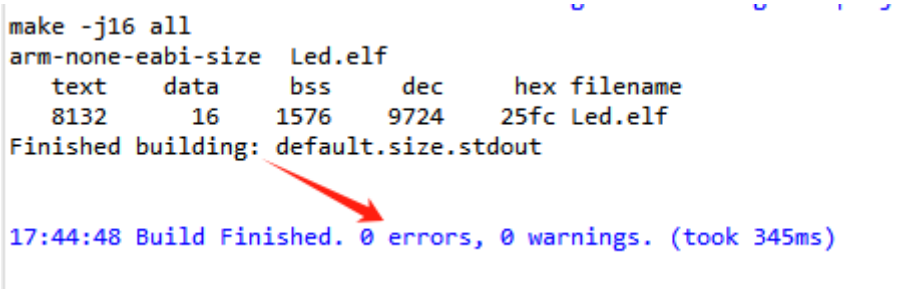
```
while (ros_error < 3)
    {
        rclc_executor_spin_some(&executor, RCL_MS_TO_NS(ROS2_SPIN_TIMEOUT_MS));
        vTaskDelayUntil(&lastWakeTime, 10);
        // vTaskDelay(pdMS_TO_TICKS(100));
    }
```

4. Compile, download and burn firmware

Select the project to be compiled in the file management interface of STM32CUBEIDE and click the compile button on the toolbar to start compiling.



If there are no errors or warnings, the compilation is complete.



Since the Type-C communication serial port used by the microros agent is multiplexed with the burning serial port, it is recommended to use the STlink tool to burn the firmware.

If you are using the serial port to burn, you need to first plug the Type-C data cable into the computer's USB port, enter the serial port download mode, burn the firmware, and then plug it back into the USB port of the main control board.

5. Experimental Results

Note: When using ROS2 to control the car's motor, it will rotate. Please place the car in the air first to prevent it from moving around on the table.

The MCU_LED light flashes every 200 milliseconds.

If the proxy is not enabled on the main control board terminal, enter the following command to enable it. If the proxy is already enabled, disable it and then re-enable it.

```
sh ~/start_agent.sh
```

After the connection is successful, a node, a publisher and a subscriber are created.

```
[1752461105.185669] info     | TermiosAgentLinux.cpp | init
| running...             | fd: 3
[1752461105.185963] info     | Root.cpp              | set_verbose_level       | l
ogger setup             | verbose_level: 4
[1752461105.650832] info     | Root.cpp              | create_client           | c
reate                   | client_key: 0x197506DD, session_id: 0x81
[1752461105.650881] info     | SessionManager.hpp    | establish_session       | s
ession established      | client_key: 0x197506DD, address: 0
[1752461105.682598] info     | ProxyClient.cpp       | create_participant      | p
articipant created      | client_key: 0x197506DD, participant_id: 0x000(1)
[1752461105.686516] info     | ProxyClient.cpp       | create_topic            | t
opic created            | client_key: 0x197506DD, topic_id: 0x000(2), participant_
id: 0x000(1)
[1752461105.690157] info     | ProxyClient.cpp       | create_subscriber       | s
ubscriber created       | client_key: 0x197506DD, subscriber_id: 0x000(4), partici
pant_id: 0x000(1)
[1752461105.694400] info     | ProxyClient.cpp       | create_datareader       | d
atareader created       | client_key: 0x197506DD, datareader_id: 0x000(6), subscri
ber_id: 0x000(4)
```

Open another terminal and view the /YB_Example_Node node.

```
ros2 node list
ros2 node info /YB_Example_Node
```

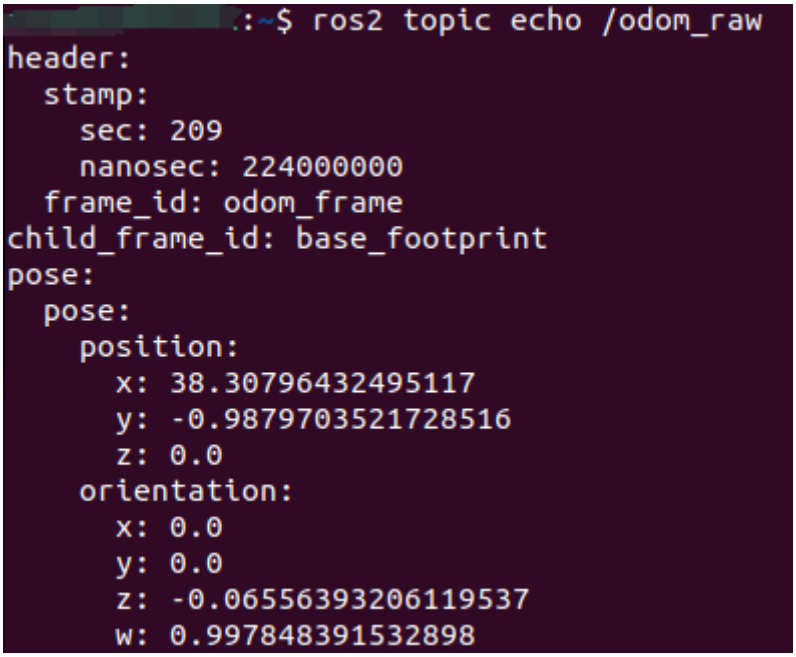
Publish data to the /cmd_vel topic to control the robot car to move forward at 0.5m/s.

```
ros2 topic pub --once /cmd_vel geometry_msgs/msg/Twist "{linear: {x: 0.5, y: 0.0,
z: 0.0}, angular: {x: 0.0, y: 0.0, z: 0.0}}"
```

Subscribe to the data of the /odom_raw topic,

```
ros2 topic echo /odom_raw
```

Press Ctrl+C to end the command.



```
twist:
  twist:
    linear:
      x: 0.49662500619888306
      y: 0.0
      z: 0.0
    angular:
      x: 0.0
      y: 0.0
      z: -0.031521592289209366
```

Check the frequency of the /odom_raw topic. A frequency of around 20 Hz is normal.

```
ros2 topic hz /odom_raw
```

Press Ctrl+C to end the command.

```
:~$ ros2 topic hz /odom_raw
WARNING: topic [/odom_raw] does not appear to be published yet
average rate: 19.561
        min: 0.025s max: 0.075s std dev: 0.01553s window: 21
average rate: 19.866
        min: 0.020s max: 0.084s std dev: 0.01700s window: 42
average rate: 19.837
        min: 0.020s max: 0.084s std dev: 0.01616s window: 63
average rate: 19.790
        min: 0.020s max: 0.084s std dev: 0.01513s window: 84
average rate: 20.008
        min: 0.017s max: 0.115s std dev: 0.01590s window: 105
```

Publish data to the /cmd_vel topic to control the robot car to stop.

```
ros2 topic pub --once /cmd_vel geometry_msgs/msg/Twist "{linear: {x: 0.0, y: 0.0,
z: 0.0}, angular: {x: 0.0, y: 0.0, z: 0.0}}"
```