Modular Programming in Embedded Systems

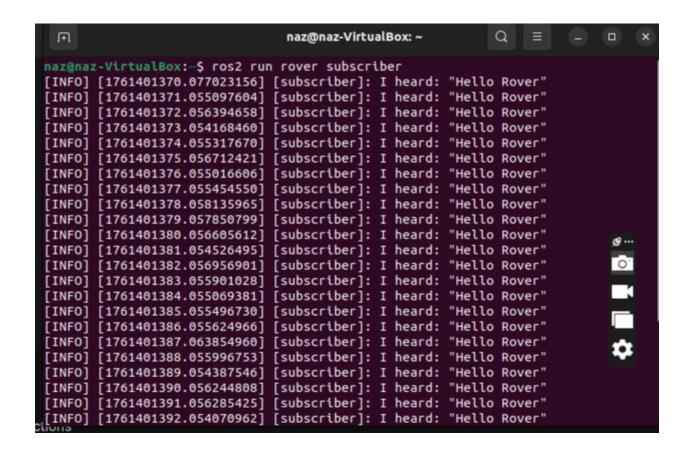Question 2:

Separating files into motor.cpp and motor.h is better than writing everything into main.ino for the following ways:

1. Can use motor.h/.cpp in other projects
2. Copying code is not needed
3. The main file seems less messy, and the code becomes understandable
4. Changes automatically apply everywhere
5. Multiple people can work on different files
6. The project can grow without looking messy
7. Debugging is easier

ROS

Question 1:

```
naz@naz-VirtualBox:~$ ros2 run rover subscriber
[INFO] [1761401370.077023156] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401371.055097604] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401372.056394658] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401373.054168460] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401374.055317670] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401375.056712421] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401376.055016606] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401377.055454550] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401378.058135965] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401379.057850799] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401380.056605612] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401381.054526495] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401382.056956901] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401383.055901028] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401384.055069381] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401385.055496730] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401386.055624966] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401387.063854960] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401388.055996753] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401389.054387546] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401390.056244808] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401391.056285425] [subscriber]: I heard: "Hello Rover"
[INFO] [1761401392.054070962] [subscriber]: I heard: "Hello Rover"
```

```
                              naz@naz-VirtualBox: ~/ros2_ws                    Q  ≡   —  □  ×
To
  naz@naz-VirtualBox:~/ros2_ws$ ros2 run rover publisher
Ur [INFO] [1761401297.071001245] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401298.060074690] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401299.069368465] [publisher]: Publishing: "Hello Rover"
Ye [INFO] [1761401300.055272064] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401301.054186896] [publisher]: Publishing: "Hello Rover"
M( [INFO] [1761401302.055442408] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401303.053080248] [publisher]: Publishing: "Hello Rover"
7[ [INFO] [1761401304.053171975] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401305.057076379] [publisher]: Publishing: "Hello Rover"
M; [INFO] [1761401306.064885212] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401307.053225545] [publisher]: Publishing: "Hello Rover"
To [INFO] [1761401308.052786117] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401309.052839540] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401310.052951556] [publisher]: Publishing: "Hello Rover"
Ge [INFO] [1761401311.052728051] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401312.056650884] [publisher]: Publishing: "Hello Rover"
Sc [INFO] [1761401313.052938613] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401314.053156639] [publisher]: Publishing: "Hello Rover"
O| [INFO] [1761401315.054977456] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401316.053923410] [publisher]: Publishing: "Hello Rover"
   [INFO] [1761401317.053116741] [publisher]: Publishing: "Hello Rover"
30 [INFO] [1761401318.054679708] [publisher]: Publishing: "Hello Rover"
```

Question-3:

1. When too many TWIST messages are sent at 115200 rate it causes the serial buffer to overflow. As a lot of messages are sent at a comparatively slow rate, so new commands are delayed. The Arduino is stuck on processing the older commands, so it cannot answer to the newer ones, so sometimes it answers some commands and disobeys others.

2. The commands most likely gets stuck between the node and Arduino in serial communication buffer. At 115200 bps the transmission rate is comparatively slow and the

commands get stuck as it cant transmit all commands at the required time

3. The single bottleneck is the rate at which the TWIST messages are sent. It is too slow for real-time navigation commands

Github link : https://github.com/na-rai/230041155_software_recruitment/tree/main