

Code Structure of the Fuel Motion Device

1. Introduction

The main files to be change are:

1. motor.h + motor.cpp
2. main.cpp
3. Slider_Menu_GUI.cpp

2. Motor Class

The motor class is where code communicates with the hardware (motor). The **enable** function lets the selected motor use the encoder port, since this port is shared by the three motors. The **setDuty** function sends duty signal to the motor. When initialize, each motor object has its unique **id** and **increment_**. The **increase** and the **decrease** functions increase and decrease the motor position by **increment_** value, respectively. The **zstep5** boolean is used by the axial motor. When it is true, the axial step size is 5mm, otherwise, it is 1mm. The 1mm step size is used to finely locate the claw grabbing position. For axial motor, the lowest position is **63** cm, and the maximum closing position for the claw is **4**. These maximum values are set in the **increase** function.

3. main.cc

In main.cc, three motor objects are initialized to be global variables, which are also declared in Slider_Menu_GUI.cpp by the *extern* keyword. The **HAL_TIM_PeriodElapsedCallback**

20 function compares the enabled motor's set position and real position (read by
21 the encoder). If they differ, duty was sent to the motor to move it to the set po-
22 sition, i.e., the motor is controlled here. In addition, if the claw motor starts to
23 close from the fully open position, i.e., the limit switch begins to leave from the
24 trigger position (= full open position), the limit switch trigger signal is turned
25 off. If the axial motor stops 1 cm from the top limit switch, its limit switch
26 signal is also turned off.

27 The **HAL_GPIO_EXTI_Callback** function defines motor behaviors then
28 the limit switches are triggered. When the top limit switch of the axial motor
29 is triggered and **the axial motor is enabled** (this enable condition prevents
30 mistake trigger of the switch when other motor is using the only encoder port),
31 the real and the set positions are set to zero. Then, the motor is automatically
32 lowered to $z = 1$ cm. When the claw limit switch is triggered and the claw is
33 opening, the claw set and real positions are set to zero, and the claw is left at the
34 fully open position. The claw-opening condition ensures the trigger action will
35 not happen when the claw is closing (switch departs from the trigger position).
36 This is important because the switch is cheap, when the switch is releasing from
37 the trigger position, it will send trigger signal, which is not wanted. Recall that
38 we only want the trigger signal when claw is opening (switch is approaching the
39 trigger position). The claw is left at the trigger position (not bound off as the
40 axial motor) because we want it to be fully opened.

41 **4. Slider_Menu_GUI.cpp**

42 The **_aDialogCreate** variable defines the GUI layout. The origin of the co-
43 ordinate system is at up-left conner with x axis points to right and y axis points
44 down. The total x and y widths are 480 and 270, respectively. The syntax for
45 the text, edit, and button widgets can be found at Chapter 18 and 19 of Se-

46 nior_Design_Eclipse_Workspace/Middlewares/ST/STemWin/Documentation/STemWin528.pdf
47 file.

48 The **_cbCallback** function defines the fonts of the button widgets, showing
49 number of digits of the edit widgets, and most importantly, the call back func-
50 tions of the buttons. In addition, the enabled motor or all stop information is
51 shown at the left-down conner text widget.

52 The **MainTask** function shows the set positions to corresponding edit wid-
53 gets. The motor moving condition is updated at the bottom-middle text widget.
54 The limit switch condition is shown at the bottom-right text widget.

55 **5. Operation Manual**

56 *5.1. Axial motor*

57 The initial set position is -2000 cm to force homing and establishing the
58 coordinate of the z motor. The **Fuel** button sets the desired position to 6 cm.
59 The **Down** and the **Up** buttons lower and raise the axial motor by a step size,
60 respectively. The step size can be toggled between 5 mm and 1 mm by the
61 **Zstep** button, and the current step size is shown right to the **Zstep** button.

62 *5.2. Azimuthal*

63 The **C.W.** and the **A.C.W.** buttons rotate the azimuthal motor clock-wise
64 and anti-clock-wise, respectively, when look down.

65 *5.3. Claw*

66 The **Open** and the **Close** buttons open and close the claw. Before the
67 operation, make sure the claw is at about half open (position = 2 or 3). Then,
68 open the claw to trigger the switch (fully open position), which set the desired
69 and current position to zero. The claw is soft protected to be fully closed to
70 position of 4. Note when claw is at switch limit position, it can still be opened

71 further since the switch will not send out signal. This setting is preserved in case
72 the fuel element can not drop at the trigger position. Then we open the claw
73 further to drop it at the price of breaking the claw coupling between the motor
74 and the thread, which can be fixed later. Remember, when claw is fully opened,
75 **the next operation is close! Do not open it further unless necessary!**
76 After the experiment, move the claw to the half open position (2 or 3).

77 **References**