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 grabing 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**

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

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

4. Slider_Menu_GUI.cpp

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

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

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

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

5. Operation Manual

5.1. Axial motor

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

5.2. Azimuthal

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

5.3. Claw

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

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

5.4. Tip

Press stop button after each operation. Then, change the desired position of intended motor. If everything is OK, enable the motor.