## Task 4: Connect to STM32-Based SPI Device

* *(a) Introduction and High-Level Description*
  + The purpose of this to build a IIR filter using the ADC and DAC function in the DISCO board. The board will read a input signal and process it. The output is a processed signal.
  + The filter equation is given in the lab instruction, here student needs to implement it in two ways, c equation and MAC assembly.
  + The basic idea of this IIR filter is the output is a sum of current input, last two input, and the last output signal voltage. Each with different coefficient.
  + Flow chart is attached in the appendix
  + Wire connection:

Table 2: Task 4 schematic

|  |  |  |
| --- | --- | --- |
|  | Connected to | Connected to |
| ADC | A0 DISCO board | Discovery board wave generator W1 |
| DAC | A1 DISCO board | Discovery board oscilloscope 2 |
| Ground | GND DISCO board | Discovery board ground |
| Oscilloscope 2 | GND DISCO board | Oscilloscope 2- |
| Oscilloscope 1 | Discovery board wave generator W1 | GND |

* *(b) Low Level Description*
  + The ADC and DAC setting are the same as task 2
  + Students used the converted result directly for the signal processing, so there is a possibility of overflow. To solve this problem, students used double variable for c equation. And device the coefficient by 1000 for the MAC assembly. After the calculation, the result will multiply by 1000.
  + To verify the filter, network function in the Analog discovery board is used. It automatically set the wave generator and use two oscilloscope to read the filter output and the wave generator output.
  + For each loop, the program will get the current value and calculate the output value with all previous data, then update the previous data.
  + User pushbutton will be used for interrupt to choose the running model. Interrupt EXTI0 is used here for interrupt.
* *(c) Results and Analysis:*
  + The program worked as expected
  + MAC assembly works better than c equation. Directly use FPU has a better performance.
  + The result are as followed. Zeros showed in the figure.