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| **Mark** |  |

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| Team name: | *A2* | | |
| Homework number: | *HOMEWORK 10* | | |
| Due date: | 17/12/23 | | |
|  |  |  |  |
| Contribution | NO | Partial | Full |
| Hui Jiang |  |  | *x* |
| Mattia Sironi |  |  | *x* |
| Gabriele Landi |  |  | *x* |
| Arturo Caliandro |  |  | *x* |
| Luigi Lizzini |  |  | *x* |
| Notes: none | | | |

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| Project name | IR communication between two boards and finally implementing a transceiver on one board. | | |
| Not done | Partially done  (major problems) | Partially done  (minor problems) | Completed |
|  |  |  | *x* |
| Explanation:  We successfully completed the homework.  Next, we explain all the steps for completing the homework:  Project 1:  Transmitter:  Firstly, we have configured the board as shown below:  Where we have just set the PB10(which is connected to the IR LED) to TIM2\_CH3.  Then, we have configured the timer 2 as shown below in order to generate PWM in its channel 3:  Where we have put the Counter Period to 2210(2211/84e6 == 1/38e3). And we put Pulse to 1105 in order to have a 50% duty cycle.  In order to set the baud rate to 2400bps, we have configured the timer 3 as shown below:  Finally, in the GUI, we enabled the following interrupt in the NVIC table:  In the main, we first defined a variable to indicate a bit is finished transmitted(0 no,1 yes):  Then we created a function in order to just send one byte:  In this function, we first start the timer 3 in interrupt mode(timer 3 is the timer we set to control the baud rate). Then we first send the start bit 0, then we wait until the bit is finished sending using the while. The variable bitfinished will be changed to 1 in the callback function of timer:  So every 1/2400 second, the bitfinished will be set to 1 which corresponds to the baud rate 2400bps.  When the start bit is finished, we stop the PWM. With the same way, we send the 8 bits of the byte in the for loop. Finally, we send the stop bit in the same way and we stop the timer 3.  After doing that, we creadted another function to send the message using the above function:  Finally, in the main, we defined the message we want to send in this first project and send it continously in the infinite while:    And this end our explanation of the transmitter of project 1.  Receiver:  First, we have configured the board as shown below:  Where we have just configured the PA9 and PA10 to USART1\_TX and USART1\_RX respectively. The UART2 is configured by default.  Then,we have configured the USART1 as shown below:  Where we have set the Baud Rate to 2400 as requested and Data Direction to Receive Only.  And we just keep the default settings of UART2:  As requested to use the interrupt mode of USART1 and USART2, we went to NVIC table to enable them:  In the main.c, we first define a global variable o receive the data:    Then, in the main, we just make the USART1 to receive data in interrupt mode:    When this operation is finished, its corresponding callback function will be called(and the furture same operations will also):    In its callbaclk function, we just send the receive byte using USART2 to our PC. Then make USART1 to receive the next byte.  Finally, it works as we expected:  But we just need to put the two boards very close.  Project 2:  In this project, instead of using LED matrix, we decided to use the LCD.  Transmitter:  first, we have configured our board as shown below:  The only difference with the previous transmitter is that we added the configuration for the button matrix.  Then, we have configured the timer2,3 and 10 as shown below:        The timer 2 and 3 are for the same purpose of the previous transmitter project. We use the timer10 in order to control the scanning frequency of the button matrix.(what we have done in the homework09)  Finally in the GUI, we have enabled the following interrupts:  As you may notice, we have changed the priority of the timer 3 to 1 which means a lower priority. We will explain it later.  As the previous homework, we defined the following macros:  And the same global variables for the same purposes(even with the same name):    And we have also defined the same OUR\_UART\_SendByte function:    In the main, we do the same thing as the homework09 in order to scan the first column of the button matrix before the first iteration of the callback function:    Then we defined the callback function for the two timers:    The timer 3 we used to control the baud rate while the timer 10 to scan the button matrix and when detect a button is pressed(also after the debounce time), we send the symbol represented by the pressed button using the function Our\_UART\_SendByte. But here is the problem, we call the function Our\_UART\_SendByte when the callback function of timer10 is called, howecer in the function Our\_UART\_SendByte, we also initialize the timer 3 in interrupt mode, and when every bit is finished sending, will call the callback function of timer3. We have tried that if we put the two interrupts in the same priority, after press the first button, the board stop working.That is because in this case, when we pressed the fisrt button, timer 3 is activated and then generated interrupt but at the meantime, timer10 is still counting and in its intterupt mode, and both with same priority, something wrong happens. Therefore, in order to solve this problem, we set the a lower priority for the timer10 interrupt.  Then, we finished our explanation of the transmitter of the project 2.  Receiver:  we fisrt configured our board as shown below:  in comparison with the previous receiver, we have just add the pin configuration for the LCD.  Then we configured the USART1 as shown below:  Exactly the same as the previous receiver.  In order to use the USART1 in interrupt mode, we enabled its interrut in the NVIC table:  In the folder of the project, we added the files for the LCD:    And in the main also added the following include:  Then we have defined the following global variables:    Where string contains the symbols is ploting on the LCD, and stringUP and stringDOWN represent the symbols is ploting on the UP and DOWN half of the LCD respectively.  Then we created the function to plot the symbols received on the LCD:  In the main, we just initialize the LCD and make USART1 to receive data in interrupt mode:    Finally, we created the USART1 callback function:    We first make the USART1 to receive the next byte, as we used a non-blocking mode of the USART, we can continue processing the received byte. Our idea is impemented a small “text editer” which means we put the receive symbols in order and display them on the LCD. When LCD is full, we reset the LCD.  Finally, the code works as we expected.  Transceiver:  In this project, instead of displaying on the LCD, we display the receive data on the LED matrix as we the professor told us is mandatory to do in this way. As the transceiver is the combination of the code for the transmitter and the code for the receiver. We don’t change the code for the former projects.  Firstly,we have configured our board as shown below:    Where we configured PB10,PA10 and PA9 for the optical commnucation,PA5,PA7 and PB6 for the control of the LCD matrix. PC2, PC3, PC12, PC13, PC8, PC9, PC10, PC11 for the button matrix.  Then we configured the timer 2 the same as the previous transmitter:  We configured the timer2 for setting the sending buad rate to 2400bps:  We configured the timer10 for scanning the button matrix in the transmitter part:  We configured the timer11 for controlling the printing frequency of the LED matrix in the receiver part:  We used the same way we used in the homework07 to configure the SPI1:    We also added a DMA in SPI1:  We configured the USART1 the same as the previous receivers:    Finally in the NVIC, we enabled the following interrupts:  Where we set the TIM10 global interrupt priority to 1due to the same reason that we have explained in the Project2 transmitter.  In the code, we defined a huge number of global variables:  But half of them is just for printing the letters on the LED matrix. And the others we just copied from the homework07,09 and the two previous projects maintaining the same name and same function.  We created the function for initialize the variable which contains all the letters in the led format:  The variable has a dimension of 256 due to the fact that in C, the variable char is of size one byte, hence 256 dfferent possible values. But in our case, we just use 16 of them.  We also defined a function for the receiver part to change the variable which contains the letter in LCD format printing on the LCD once receive a data from the transmitter.    We copied the function to send the data used in the previous projects:  We created the callback function for the timers:  As we mentioned before, timer3 control the baud rate at 2400bps,timer10 control the scanning frequency of the button matrix. These two part of the codes we just copied from the previous project. We added the part for the timer11 which is in charge of printing the received data on the LED matrix. In order to have a better performance, we used the DMA, and at the callback function of the SPI:  We updated the variable column\_index\_LED as we used a non-blocking SPI transmission function hence we need to update the the variable column\_index\_LED once the transmission operation is done.  For the USART1, we also created its callback function:  Where once received a data, we pushed the microcontroller to receive the next data immediately. And we set the new\_command to 1 in order to tell to the main funciton that we have received a data then the main knows to update the LED matrix.  Finally, in the main:    we initialized a series of variables and push the receiver part to receive data, start the timer10 and timer11 both in a safe way. And in the infinite while, if the receiver part receive a data, update the LED matrix.  Finally, the code works as we expected. | | | |
| Professor comments: | | | |