



## EE337 Microprocessors Laboratory

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Problem set: 9b project

Date: March 26, 2025

In this project, you will implement board-to-board communication using the SPI protocol. Also, you will use UART to communicate to one of the boards (Master in SPI) to start the communication.

Two boards (one Master and the other Slave) will communicate with each other over the SPI protocol using 4 pins - CLK, MISO, MOSI and  $\overline{CS}$ . The board acting as a SPI-Master will also be connected to 'Realterm' software (on your laptop) with the UART module. These two will communicate with each other over UART protocol.

### 1. **Part-1** [18] Board to Board communication using SPI:

- \* SPI protocol uses 4 pins - CLK, MISO, MOSI,  $\overline{CS}$ . Here you have one Master board and one Slave board. You have to do connections of these pins appropriately.
- \* You will establish communication between two boards using the SPI protocol
- \* You will send two prime numbers from master to slave using SPI.
- \* Slave will receive these two numbers and will check whether their addition is also a prime number or not.
- \* Addition of two received numbers will be shown on the LCD connected to the slave board.
- \* Slave board will communicate the result (prime or not prime) to the Master board.
- \* The Master board will display the message on the LCD connected to the Master board. If the addition is prime, "PRIME" will be displayed. If the addition is not prime, "NOT PRIME" will be displayed.
- \* The contents written on both LCDs (master and slave) must remain there indefinitely.



Figure 1: SPI - SPI communication

### 2. **Part-2** [7] Adding UART Protocol to the existing system of Boards communication over SPI.

- \* In the first part you have been sending two numbers directly from Master (Hard-coded). Now you have to get these numbers into the Master board from the external peripheral using UART.
- \* Connect the Master board to your laptop using the UART module provided to you. Make appropriate connections (Refer to Lab 8).

- \* Open Realterm software on your laptop. You will send two numbers from your computer to your master board using the Realterm software.
- \* The numbers received from the UART will be sent to the slave board over SPI
- \* The result received from the slave to the master will be sent to Realterm over UART.

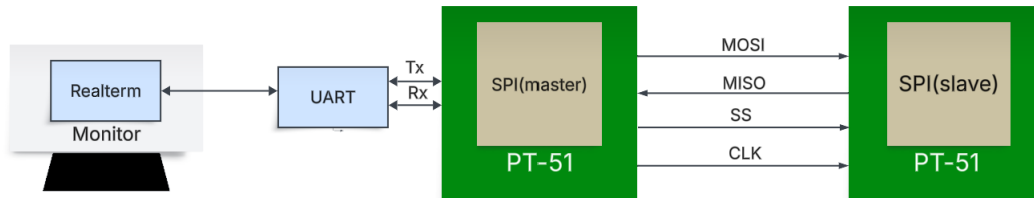


Figure 2: UART - SPI - SPI communication

### 3. **Part-2** [5] Linking asm file with C.

- \* Write the addition code in assembly and link the assembly(asm) file with the C file.
- \* In this part, the addition of numbers is done through the assembly code rather than writing the addition code in C.

### 4. **BONUS part** [10] - MAC operation.

- \* Instead of performing the addition of two numbers, perform the MAC operation.
- \* Use the MAC assembly code which you have performed in the previous lab and repeat task 3.
- \* Make the necessary changes to master and slave to perform this task.

### 5. Notes

We have already provided all the supporting files, pdfs, and template codes to you with lab 9a. Use those files to start working on the project. If you have any questions, feel free to contact your TA/RA; or Aniket Gupta (23m1168), Jaydev Bapat(23m1173)