Pt-51 Test Program

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Objective

- To test the peripherals of the microcontroller and the hardware on the Pt-51 board, i.e.
  - LEDs
  - Switches
  - PCA Module
  - SPI
  - UART
  - LCD display
  - Port Pins

Test Procedure

- Putting the switches in various positions from 0 to 7 (bit values) will test each of the peripherals

- The switches are connected to pins P1.0-P1.3 of the microcontroller

- The switches corresponding to P1.0 to P1.2 will be used for the test, with P1.0 being the LSB and P1.2 being the MSB

- Ongoing test and results displayed on LCD

Test Procedure

| Key Position (P1.2-P1.0)	Tested Peripheral
000	Timers
001	PWM module
010	Counter Module
011	SPI Module *
100	UART Module **
101	LCD Display
110	Clear Screen
All others	Timers

*Pins MOSI and MISO are to be shorted during this time
**Pins 3.0 and 3.1 (UART Rx and Tx) are to be shorted during this time
Please refer to the Pt-51 manual for identifying the pins

Defaults

- Keeping the switches in position 6(0b110) clears the LCD Screen

- All other key positions (0x07 to 0x0F) run the default test, i.e., the Timer Test

- If the test fails because the loopback wires are not connected, plug in the wires and restart the microcontroller.

- If the test fails in spite of the wires being connected, inform your TA
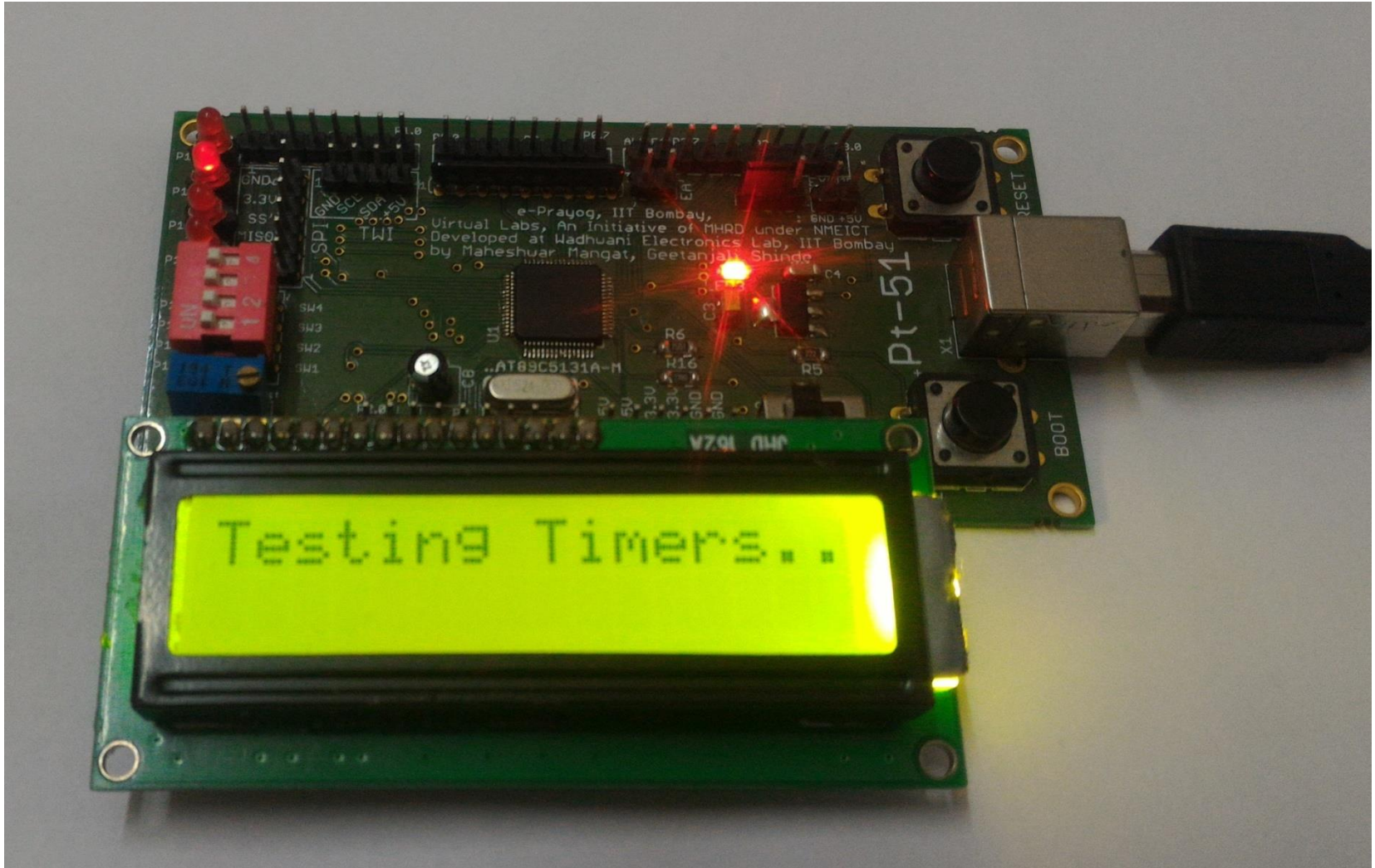
Failed Test-SPI/UART
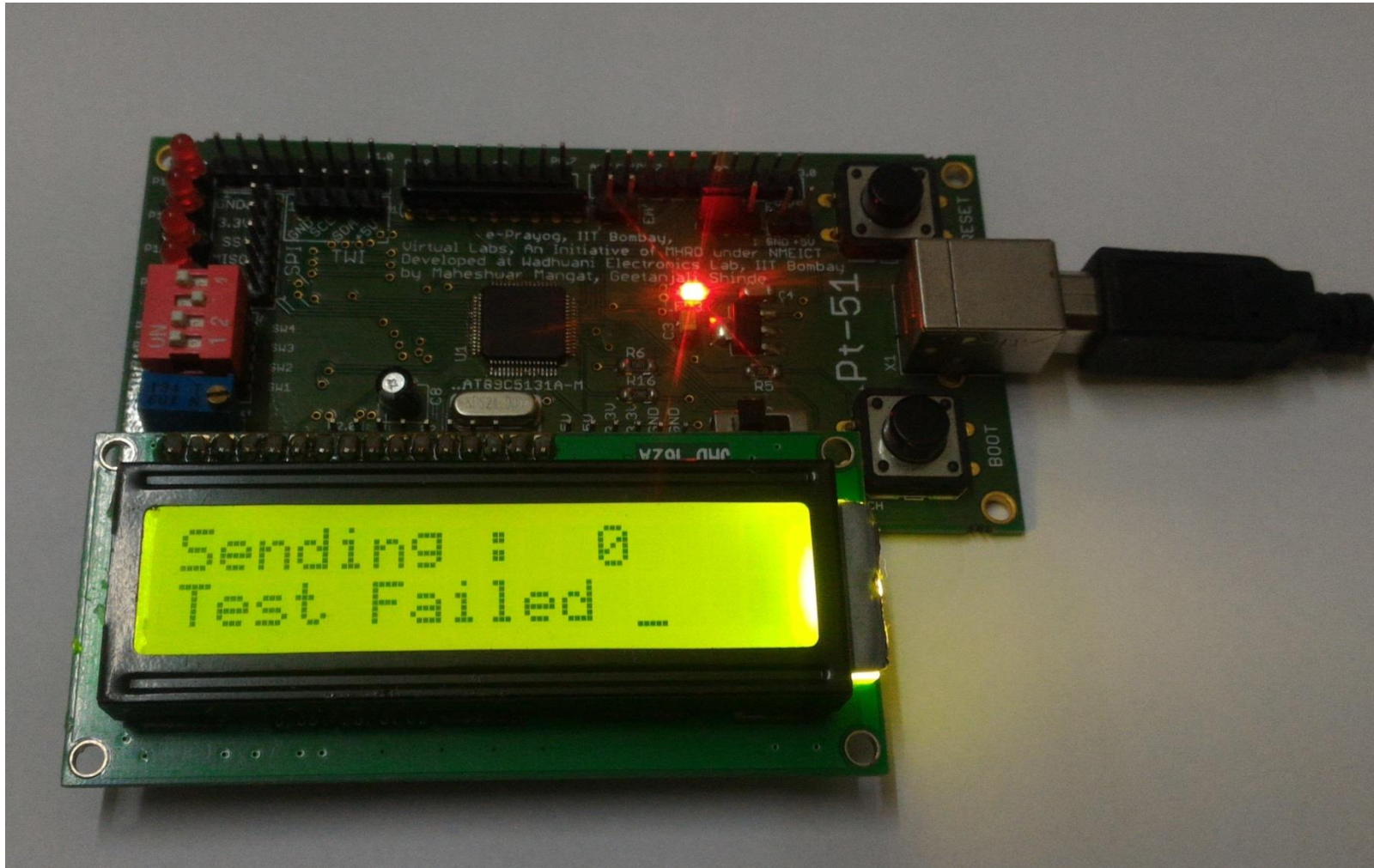
Starting the tests
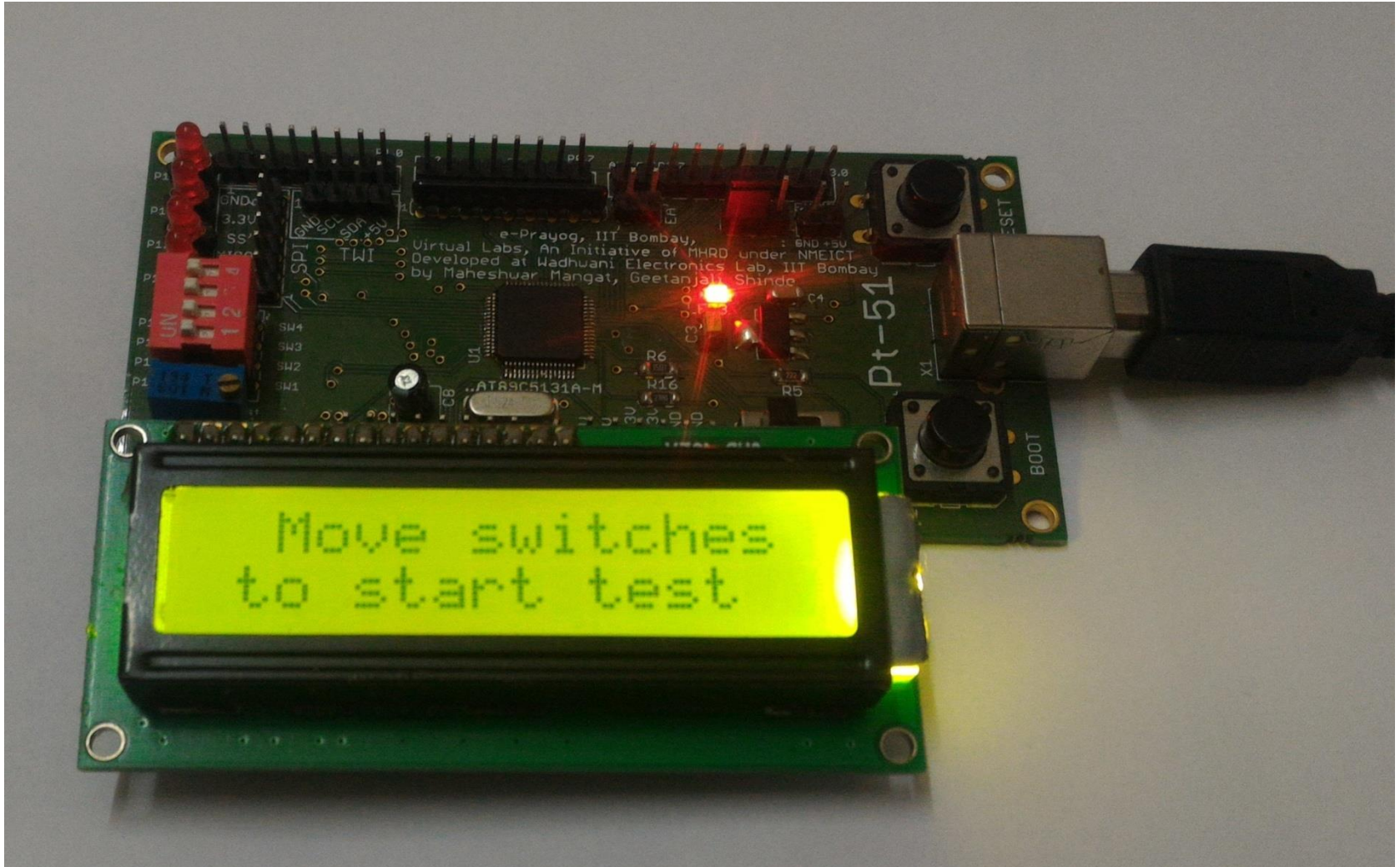
Timer Test

- How many timers does the microcontroller AT89C5131A have?
- Switches in Position 0 (0b000) for test
- Timer 0 blinks LED4 (P1.4)
- Timer 1 blinks LED3 (P1.5)
- Timer 2 blinks LED2 (P1.6)
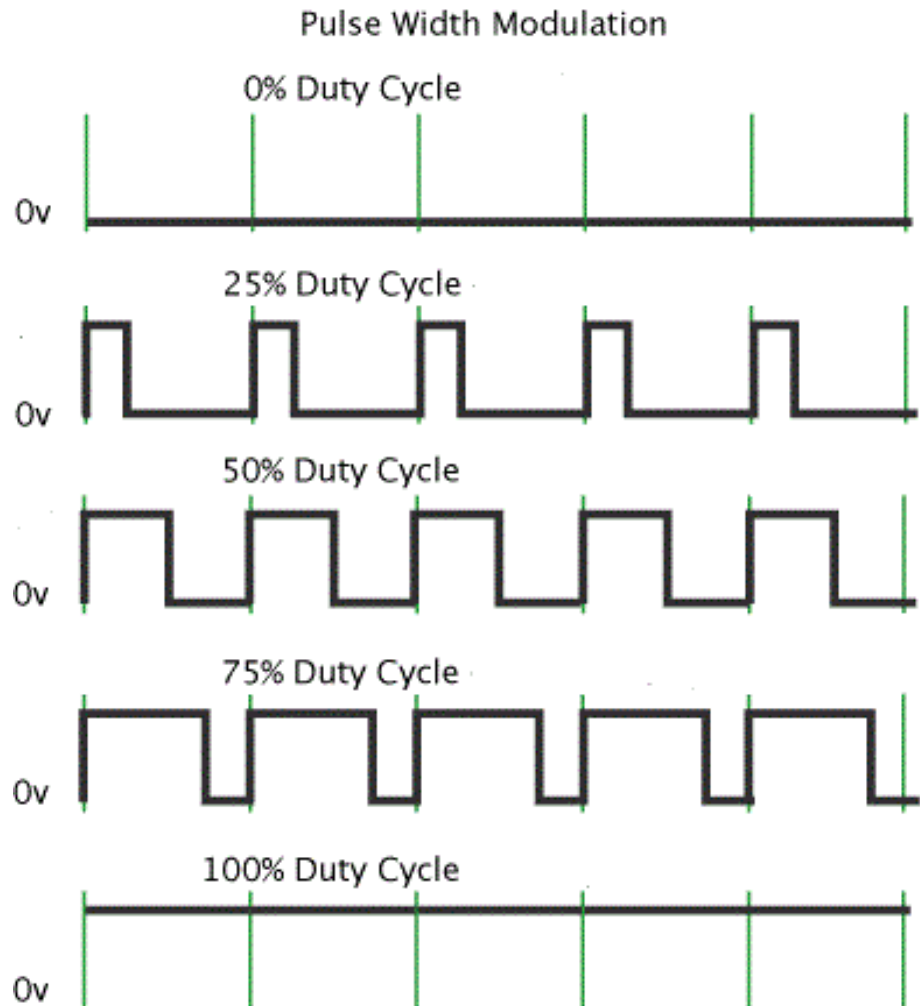- Try to guess the frequencies
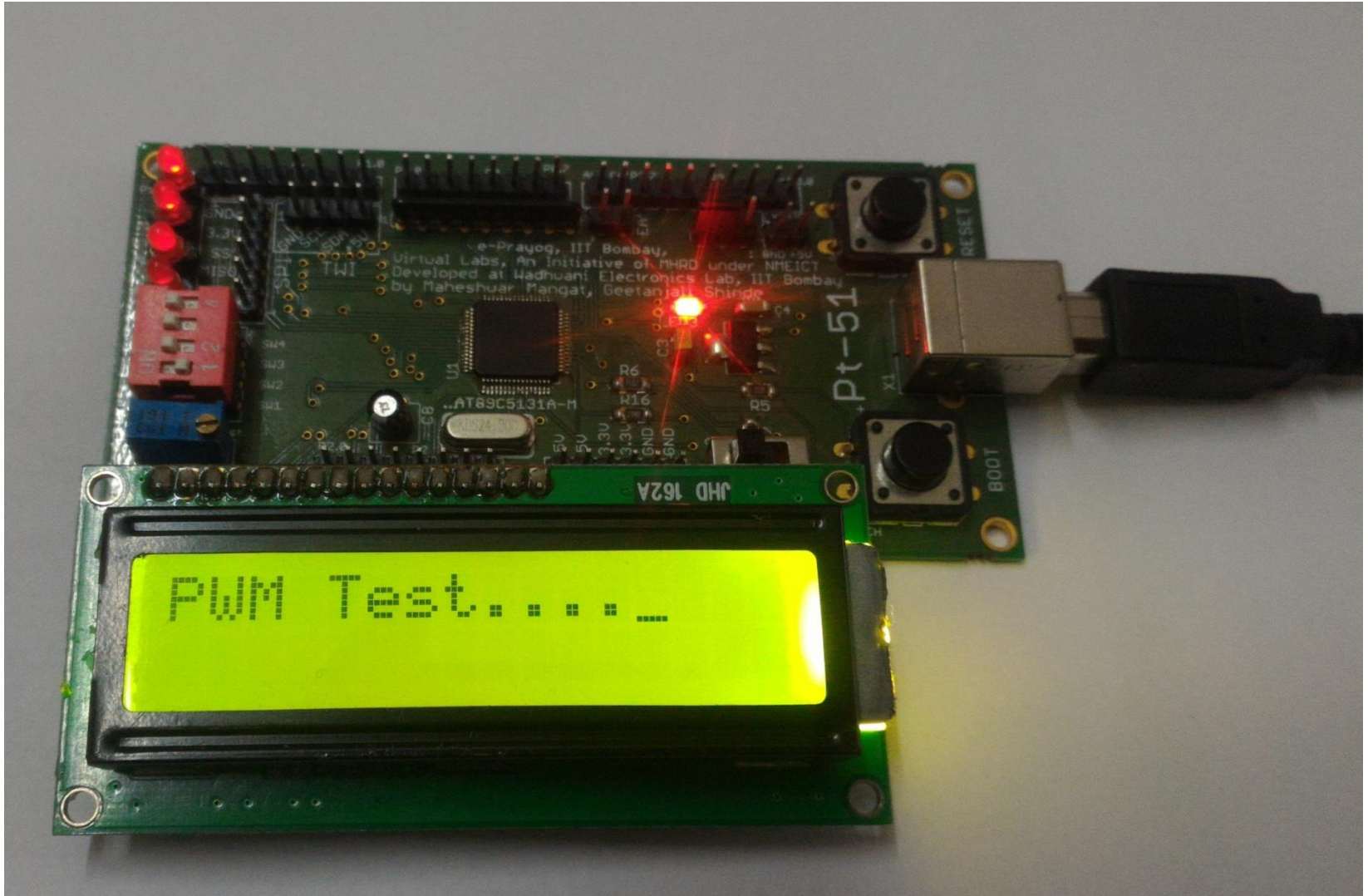
Timer Test

PWM Test

- Uses the PCA module of the microcontroller
- What does PCA stand for?
- Called CCP module in some microcontrollers
- Switches in Position 1(0b001)
- Signals of different duty cycle with the same pulse width are fed to the 4 LEDs

PWM Test

- Average voltage applied to LEDs varied by varying duty cycle

- As a result they light up with different intensities

- Try to guess duty cycles used in the program

Pulse Width Modulation

0% Duty Cycle

0v

25% Duty Cycle

0v

50% Duty Cycle

0v

75% Duty Cycle

0v

100% Duty Cycle

0v

PWM test

Counter Test

- Uses the PCA module of the microcontroller
- Microcontroller can capture events on a pin and save it into a register
- Switches in Position 2(0b010)
- Toggle switch 3(P1.2) to increment the count
- When the count reaches 5, test is finished
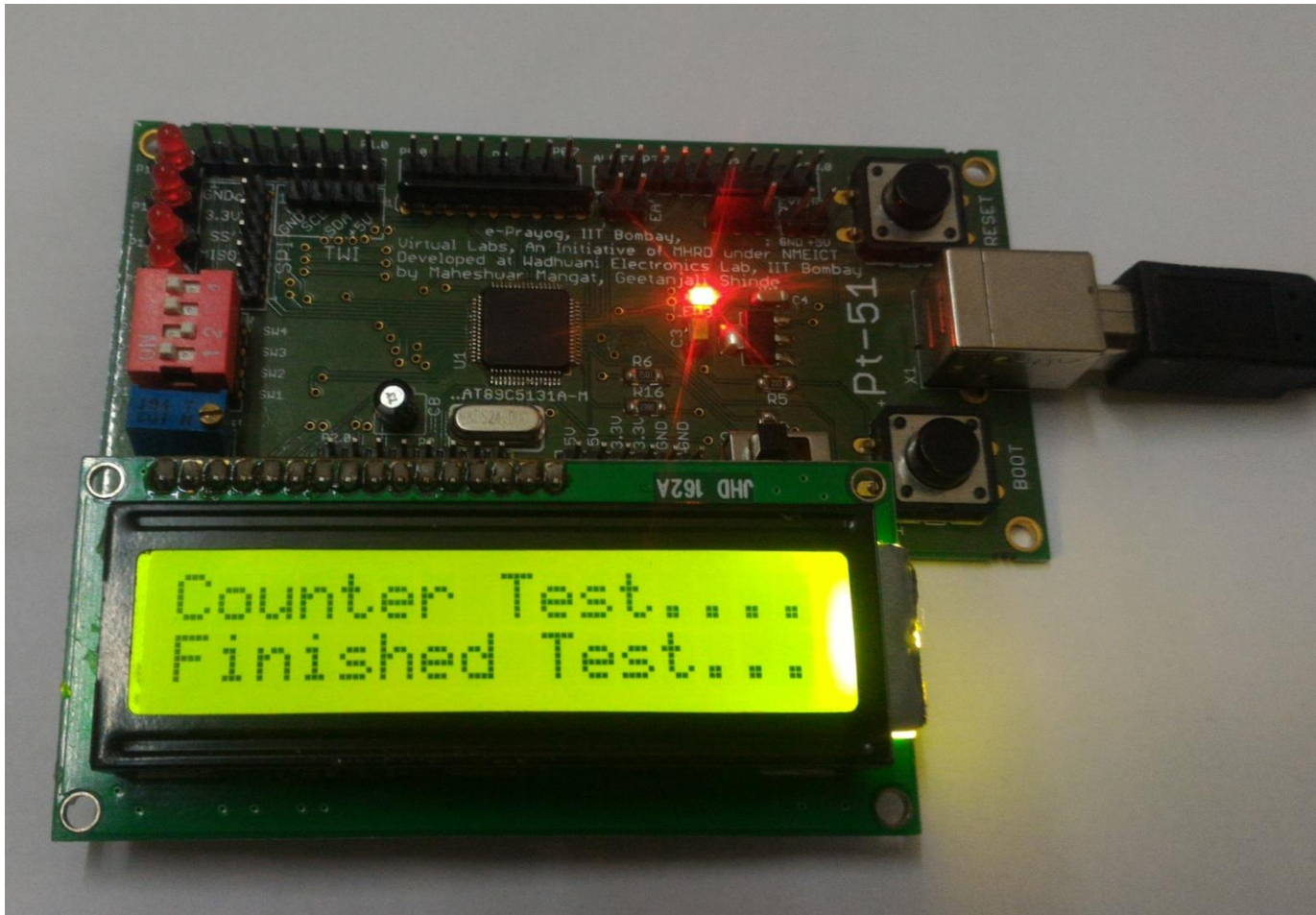- Because of bounce, count may increment by more than one for 1 toggle

Counter Test
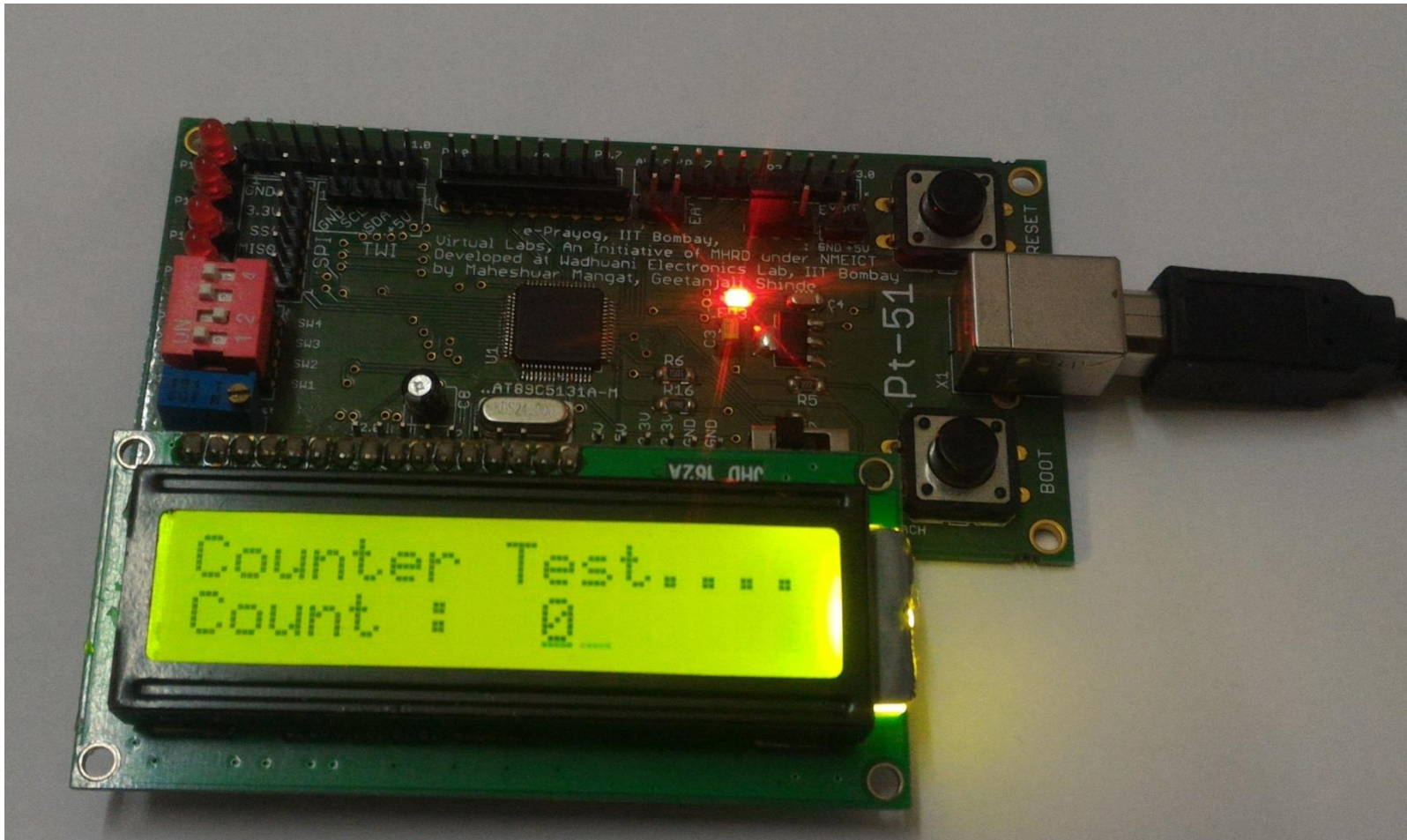
# Counter Test

Counter Test

SPI Test

- What does SPI stand for?

- Used for communication between uCs and peripherals(1 or more) or between uCs (1 or more)

- Switches in Position 3(0b011)

- Short pins MOSI and MISO before test

- Data sent over MOSI is received by MISO (Called looping back)

- If both bytes match, test is a success

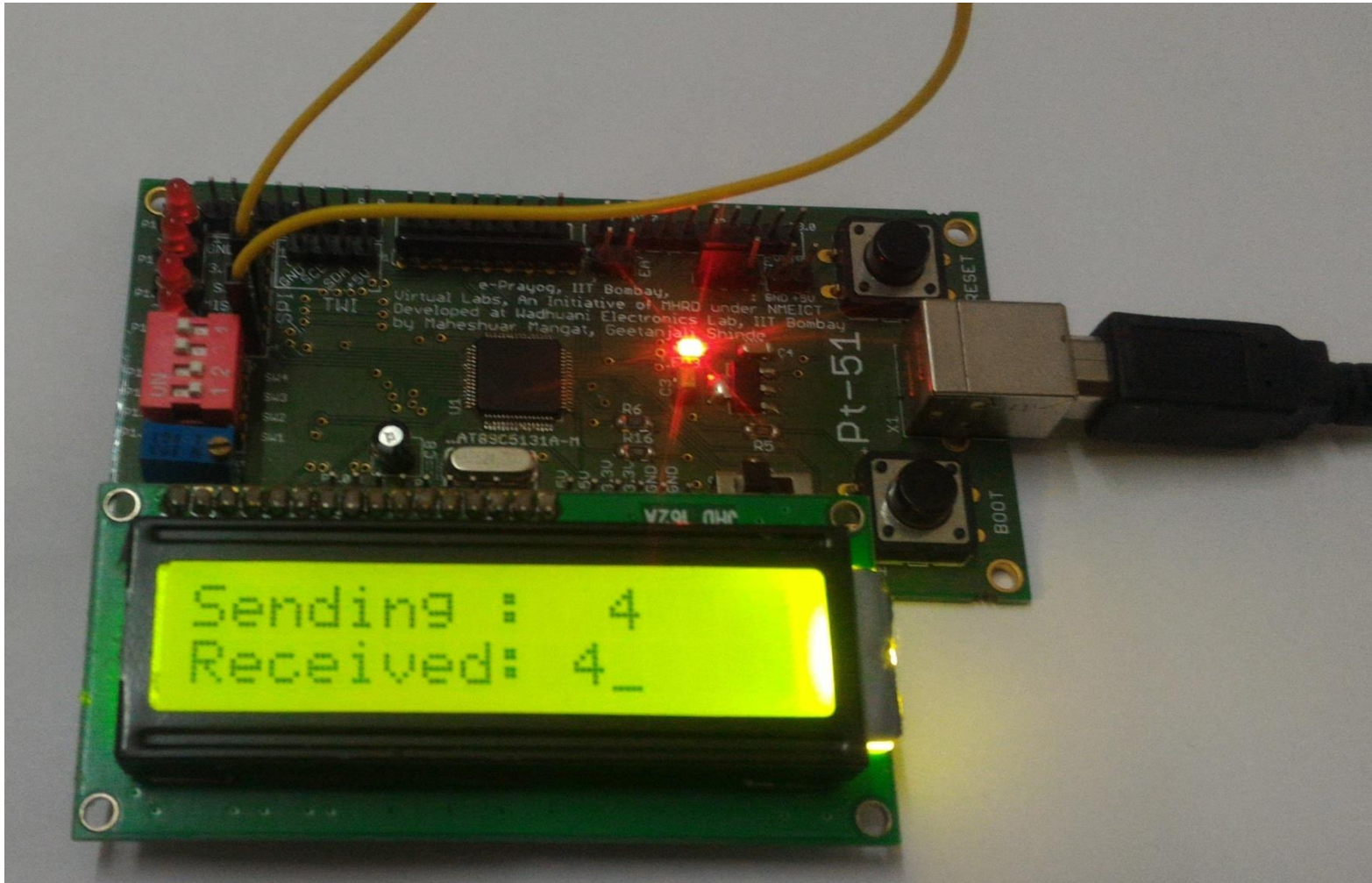- Procedure repeated 5 times

SPI Test

- SPI uses shift registers to send and receive data
- When bit 7 is transmitted by master, it is put in bit 0 of the slave. Then both registers are shifted right by one
- Transmission and shifting continues 7 more times till data is in the right place
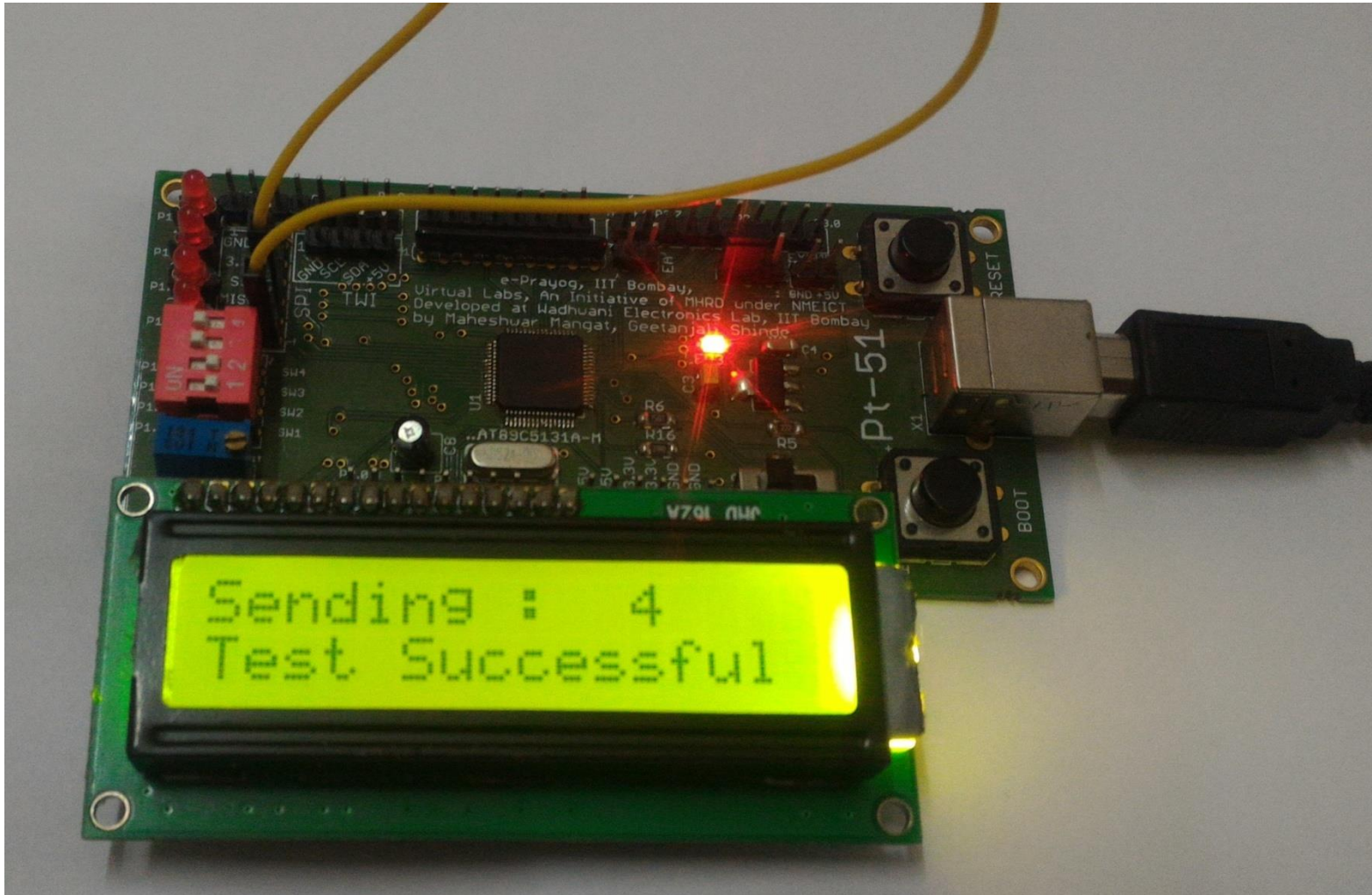
Master

Slave

Memory

Memory

SCLK

MOSI

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

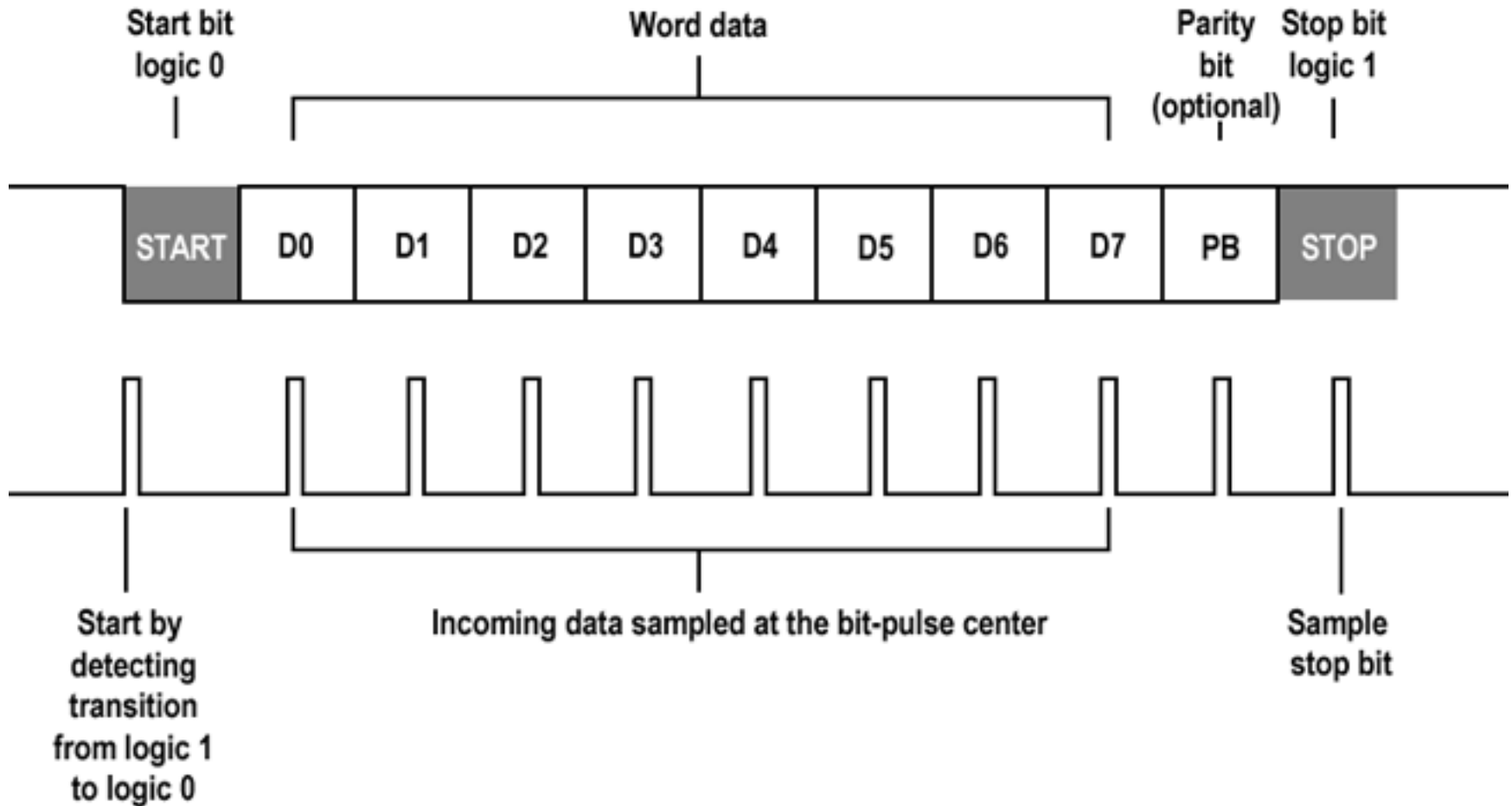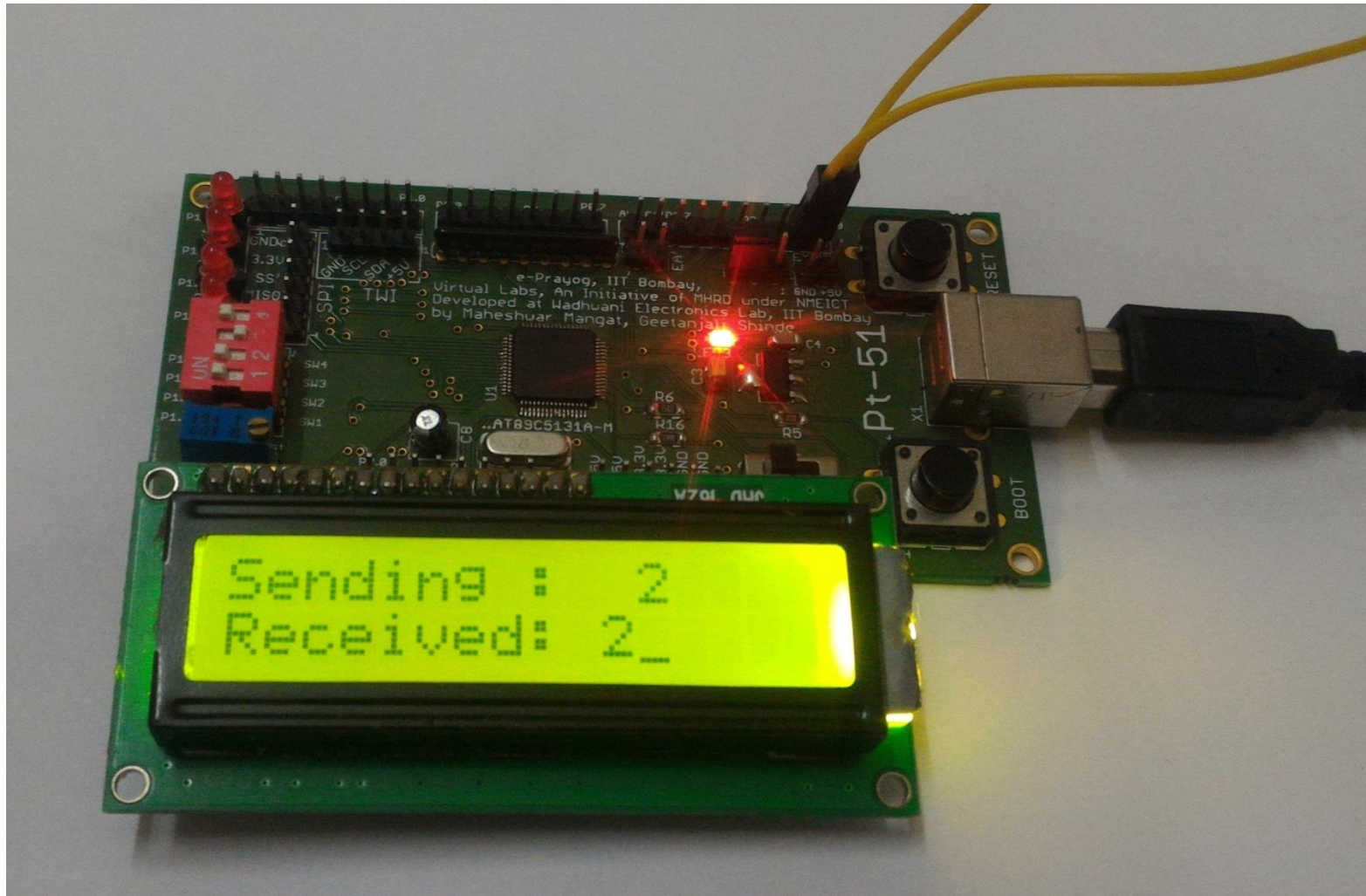| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

MISO
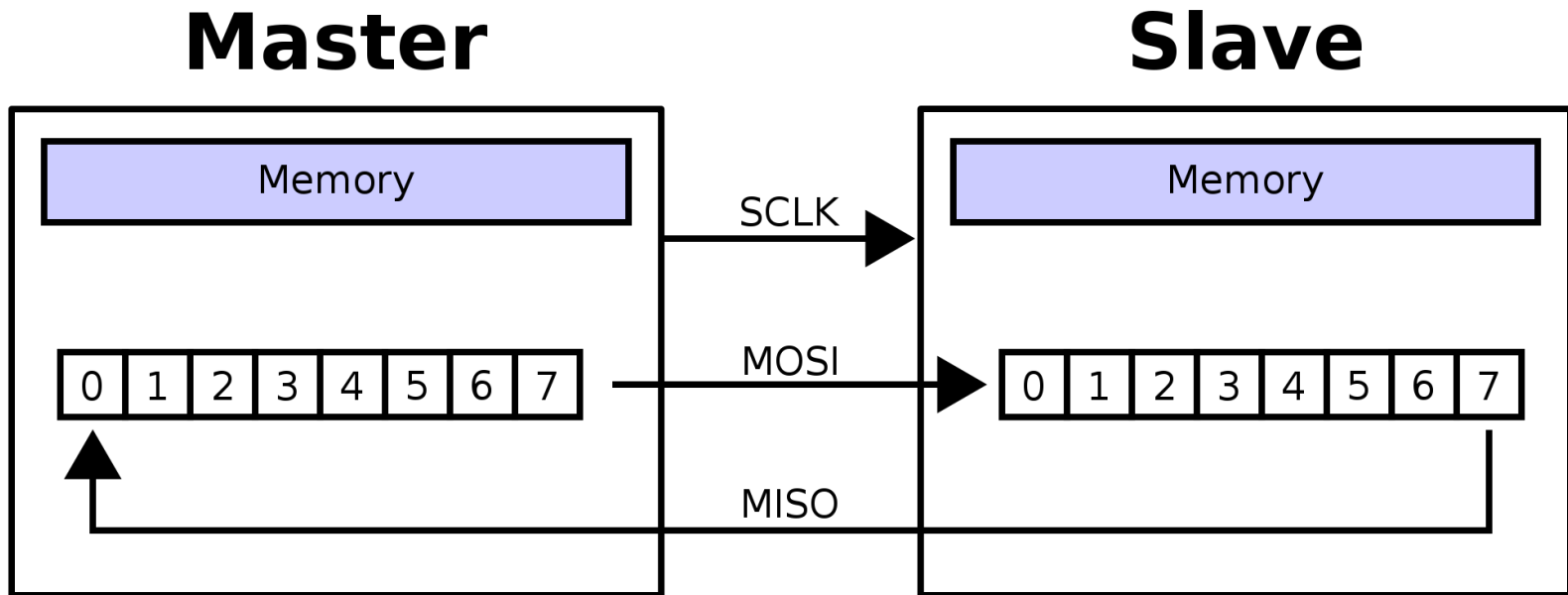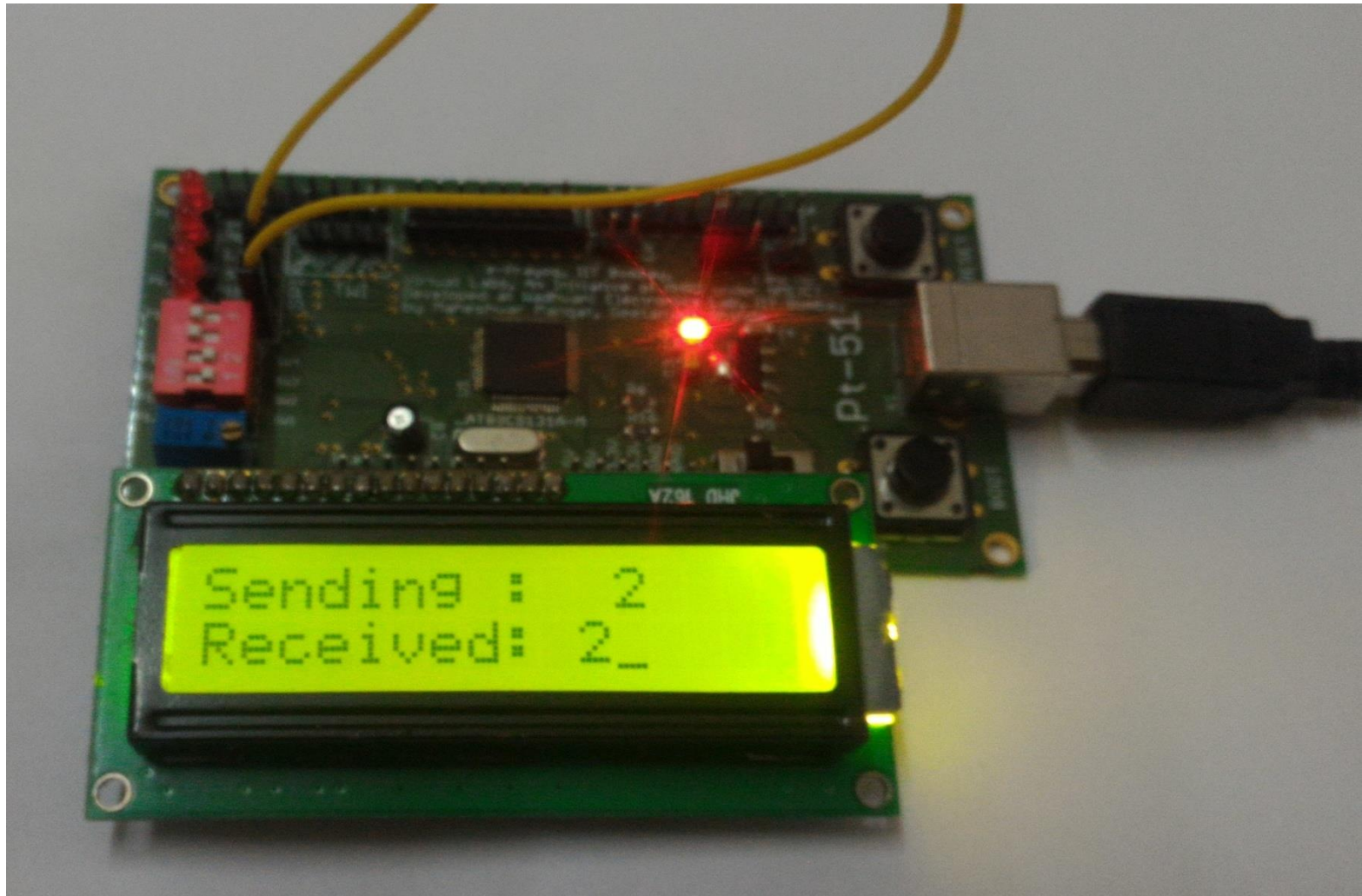
SPI Test

SPI Test

SPI Test

UART Test

- One of the most popular communication interfaces
- Stands for Universal Asynchronous Receiver Transmitter (Also called RS232)
- Switches in Position 4(0b100)
- Performs loopback as with SPI. Hence need to short UART Rx and Tx pins (P3.0 and P3.1)
- If sent data = received data, test successful
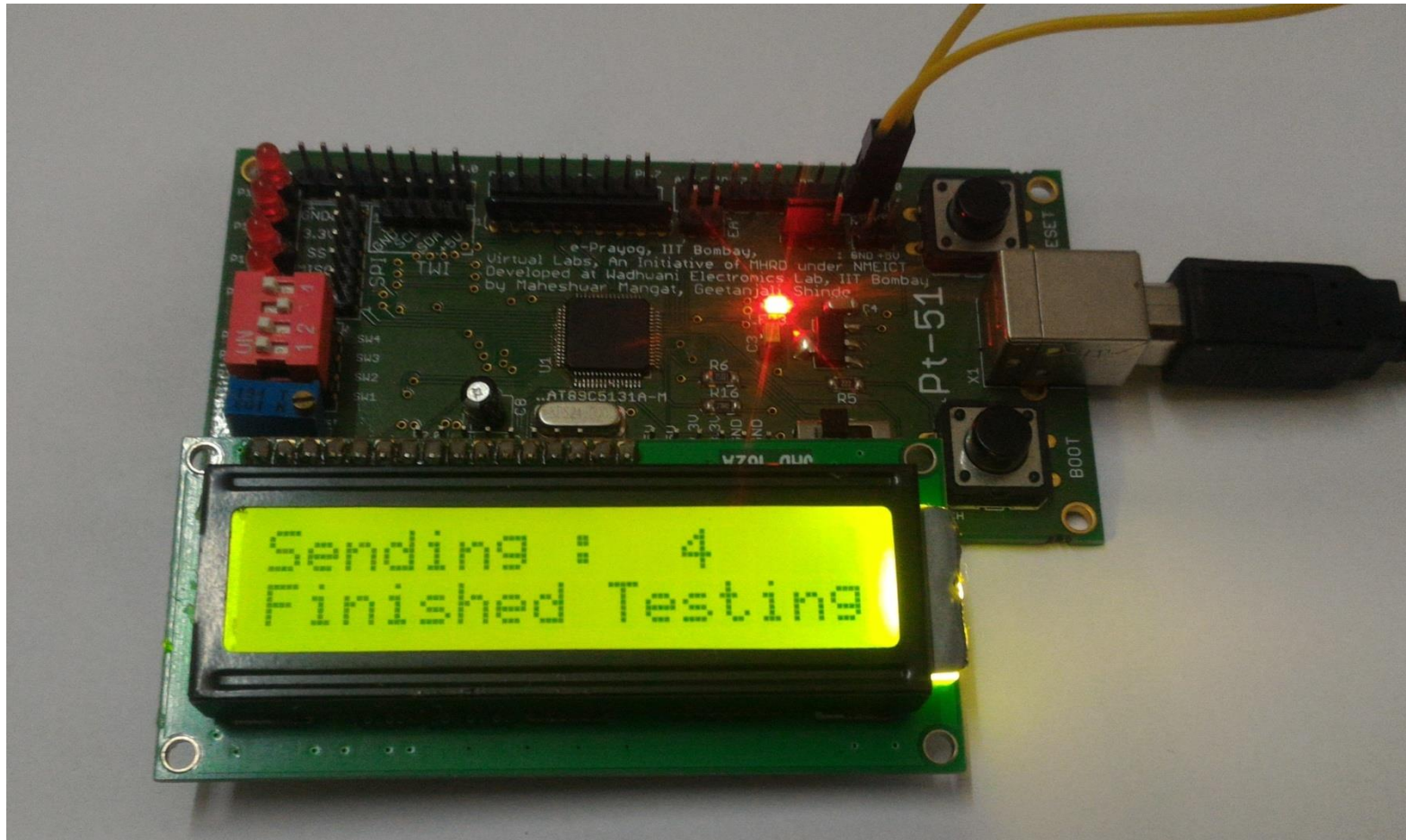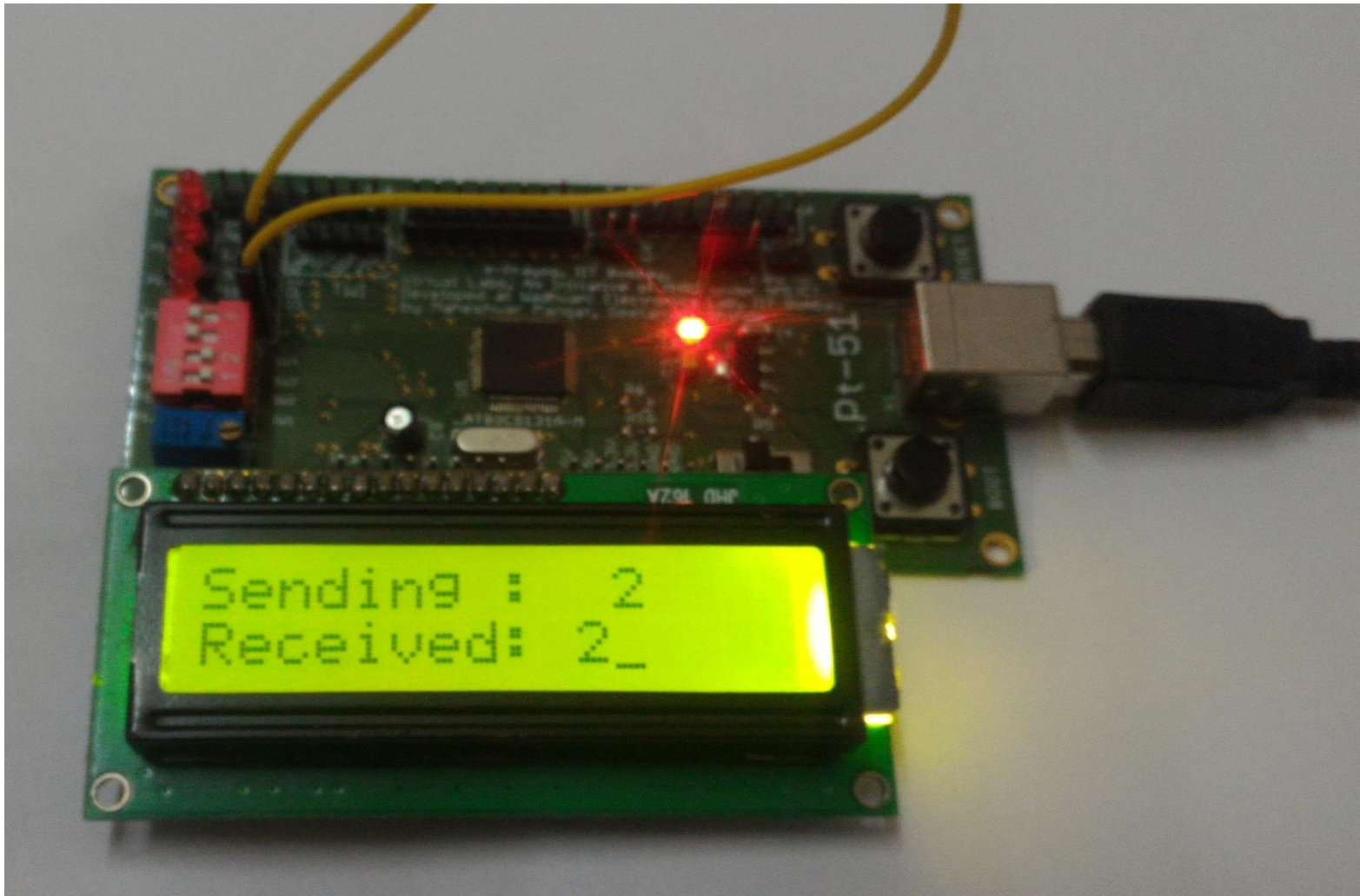- Performed 5 times

UART

UART Test

UART Test

UART Test

LCD Test

- Switches in Position 5(0b101)
- LCD has 2 lines with 16 characters each
- Program verifies if the LCD is able to display all alphanumeric characters
- The program quickly over all alphanumeric characters at every display block in both lines
- Displays 32 "Z"s at the end of the test

LCD Test

LCD Test