

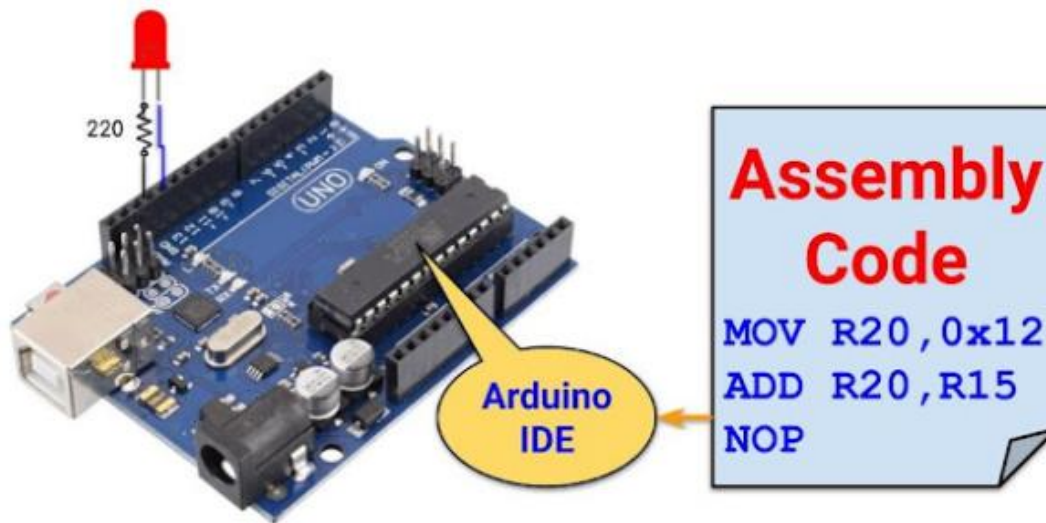


**American International University- Bangladesh**  
**Faculty of Engineering (EEE)**  
 EEE 4103: Microprocessor and Embedded Systems Laboratory

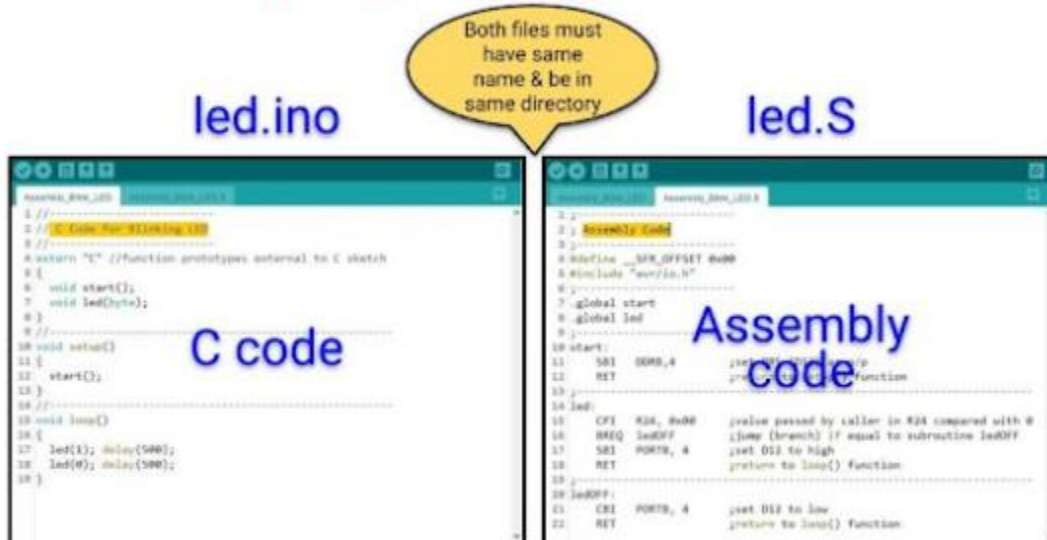
**Title:** Familiarization of assembly language program in a microcontroller.

**Introduction:** In this experiment, the main objective is to learn how to write an assembly program for a blink LED program in a microcontroller.

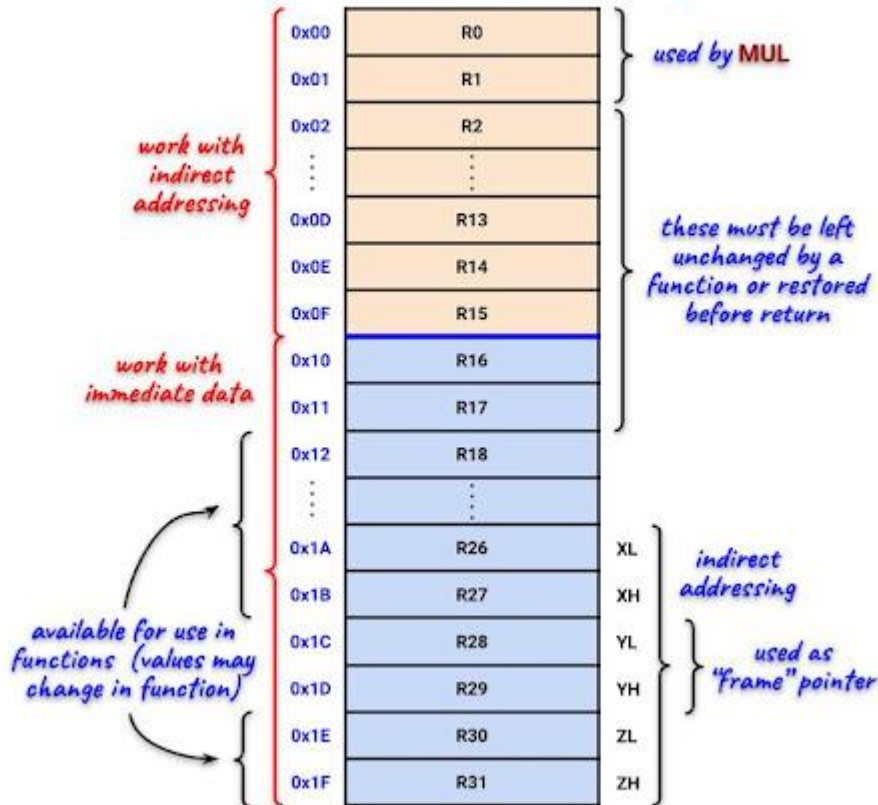
**Theory and Methodology:** Assembly language programming using Arduino IDE.



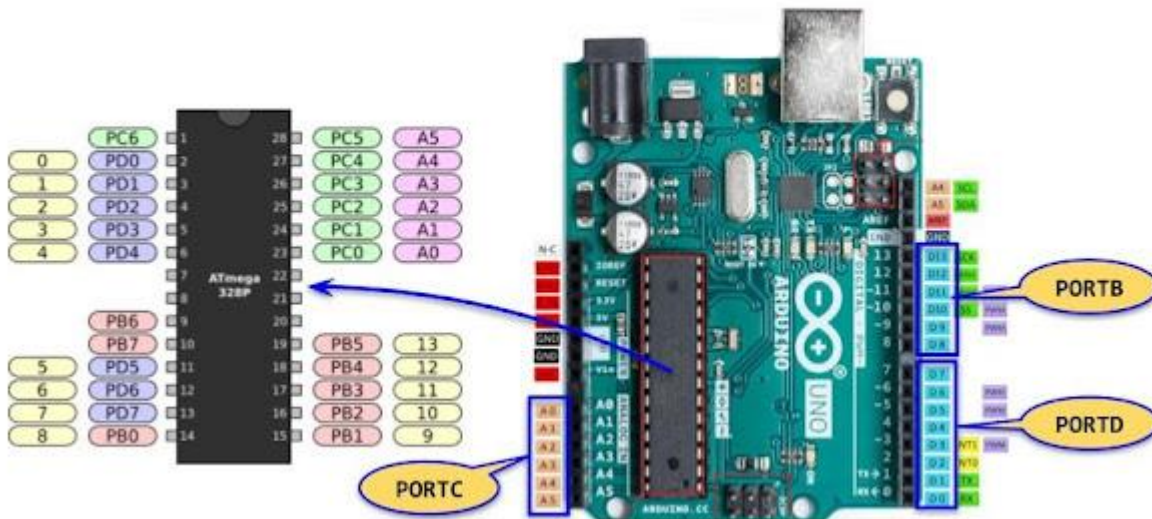
## Assembly Programming via Arduino IDE



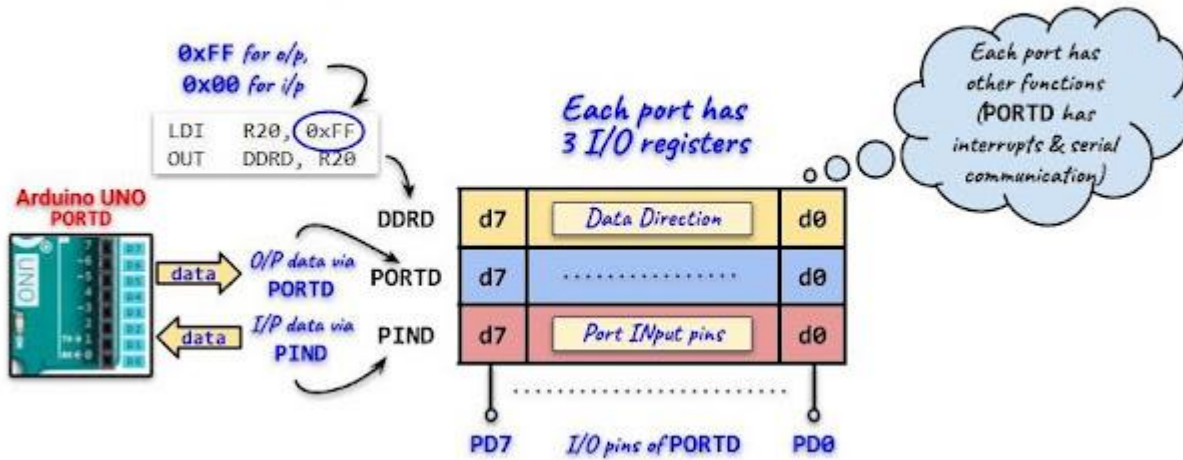
## ATmega328P MCU Registers



## Programming ATmega328 I/O Ports



# Assembly Programming of I/O Ports



## PART 1: Blink a LED

The .ino file:

```
//-----
// C Code for Blinking LED
//-----
extern "C"
{
    void start();
    void led(byte);
}
//-----
void setup()
{
    start();
}
//-----
void loop()
{
    led(1);
    led(0);
}
```

The .S file:

```
;-----
; Assembly Code
;-----
#define __SFR_OFFSET 0x00
#include "avr/io.h"
;-----
.global start
```

```

.global led
;-----
start:
    SBI  DDRB, 5      ;set PB5 (D13) as o/p
    RET              ;return to setup() function
;-----
led:
    CPI  R24, 0x00    ;value in R24 passed by caller compared with 0
    BREQ ledOFF      ;jump (branch) if equal to subroutine ledOFF
    SBI  PORTB, 5     ;set D13 to high
    RCALL myDelay
    RET              ;return to loop() function
;-----
ledOFF:
    CBI  PORTB, 5     ;set D13 to low
    RCALL myDelay
    RET              ;return to loop() function
;-----
.equ  delayVal, 10000 ;initial count value for inner loop
;-----
myDelay:
    LDI  R20, 100     ;initial count value for outer loop
outerLoop:
    LDI  R30, lo8(delayVal) ;low byte of delayVal in R30
    LDI  R31, hi8(delayVal) ;high byte of delayVal in R31
innerLoop:
    SBIW R30, 1       ;subtract 1 from 16-bit value in R31, R30
    BRNE innerLoop   ;jump if countVal not equal to 0
    ;-----
    SUBI R20, 1       ;subtract 1 from R20
    BRNE outerLoop   ;jump if R20 not equal to 0
    RET
;-----

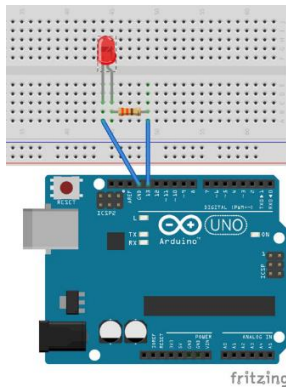
```

.

### Equipment:

- 1) Arduino Uno
- 2) Arduino IDE
- 3) One Led
- 4) One 220 ohm resistor
- 5) PC having Intel Microprocessor

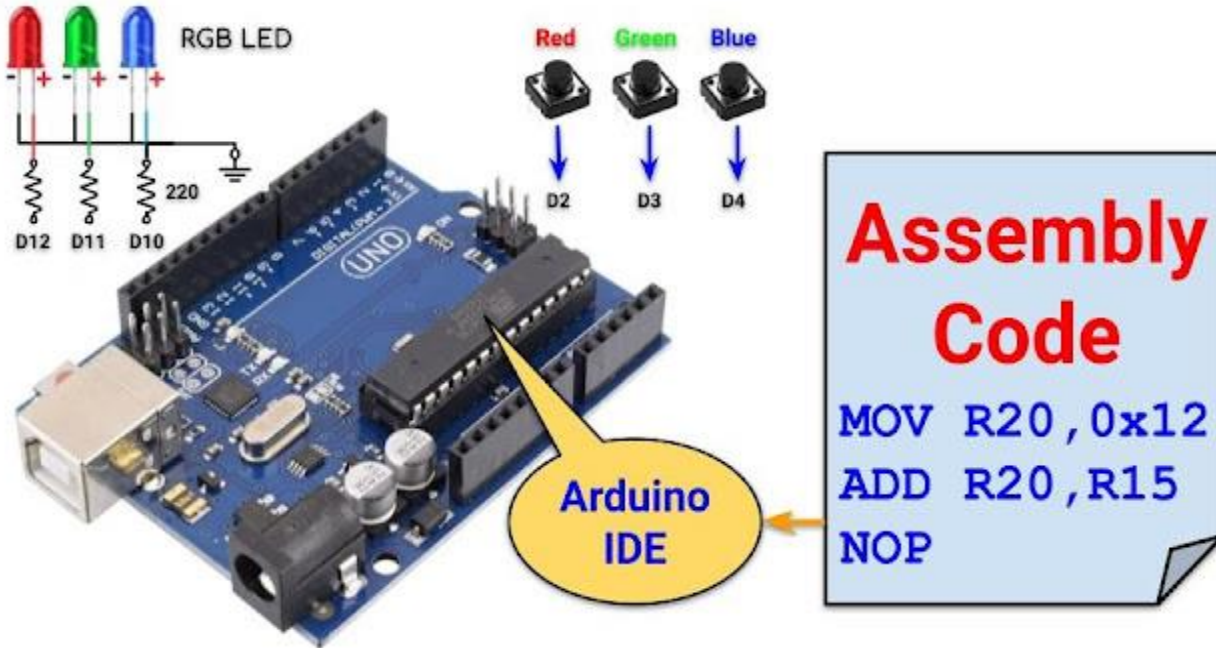
### Experimental Setup:



### Experimental procedure:

- 1) Create led.ino and led.S files using code given above.
- 2) Create a folder named led and place the above two files in the led folder.
- 3) Open led.ino using Arduino IDE.
- 4) Compile and upload to the hardware.
- 5) Modify the program to blink a led at digital PIN 12 with a different delay.

### PART 2: Push button LED control



### Self-Study:

# Use the following link to program a code in order to control 3 LED lights with 3 push buttons. Each time a button is pressed, an LED will blink for 10 times.

<https://www.youtube.com/watch?v=k8w-IOyyvhQ>

### Questions for Report writing:

1. Include all codes printouts following lab report writing template.