

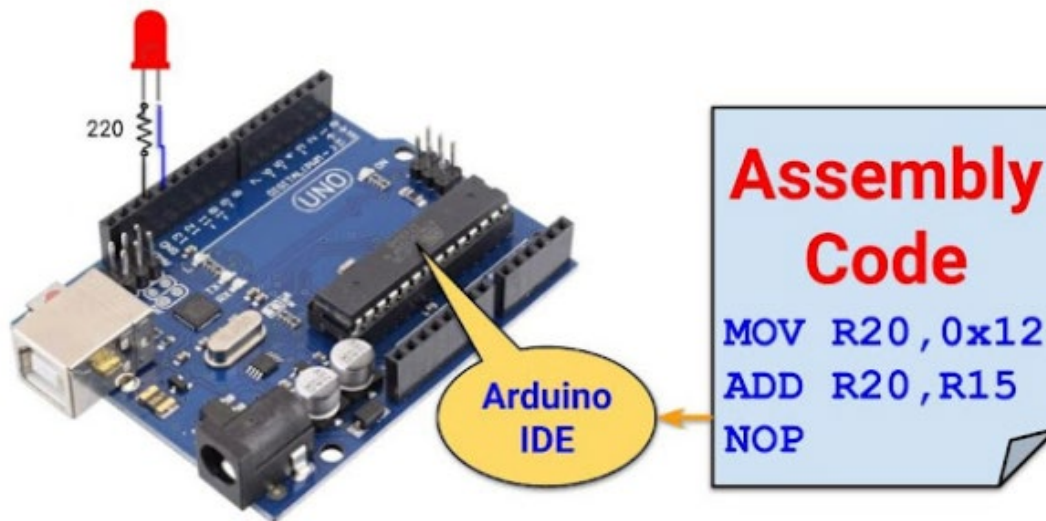


American International University- Bangladesh
Faculty of Engineering (EEE)
 EEE 4103: Microprocessor and Embedded Systems Laboratory

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.

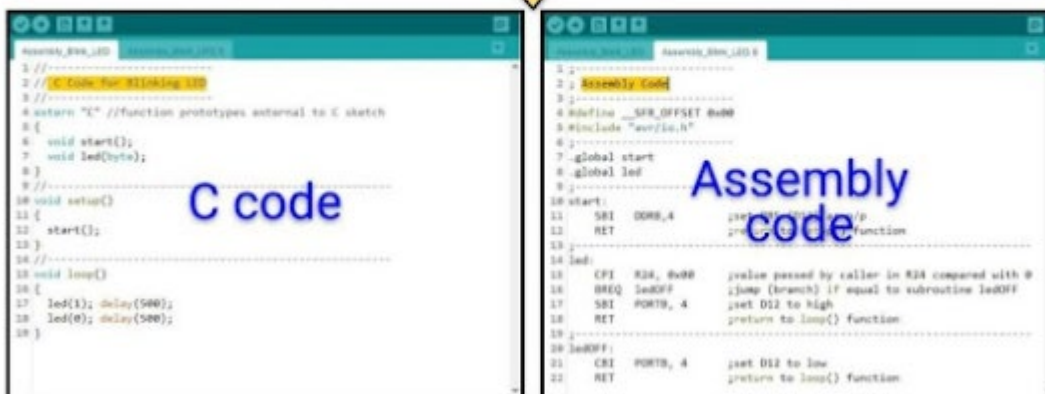


Assembly Programming via Arduino IDE

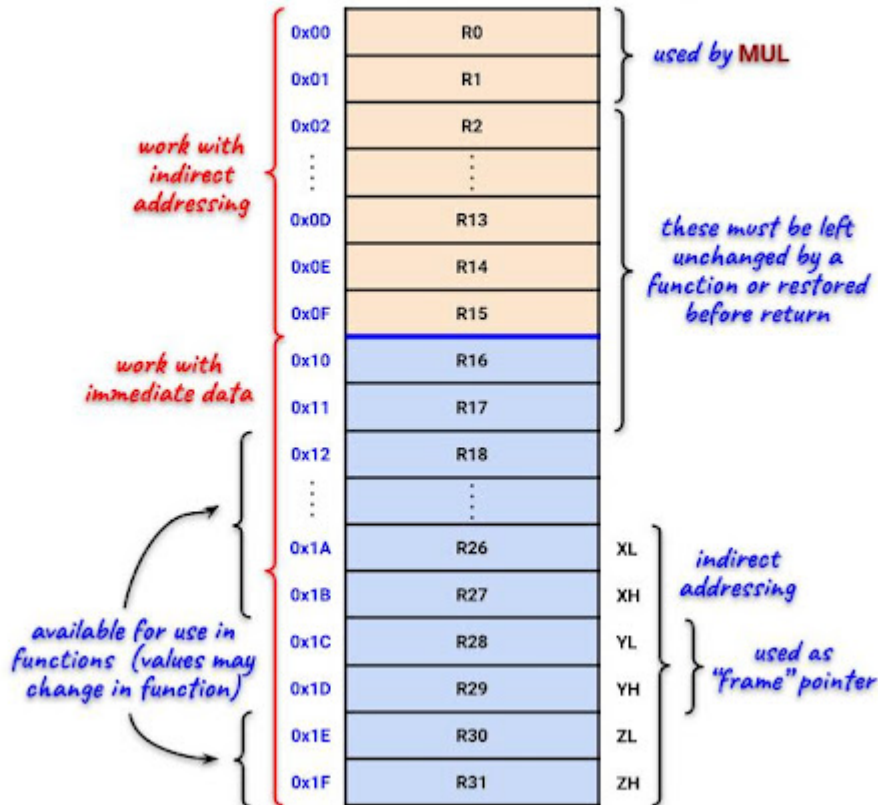
led.ino

Both files must have same name & be in same directory

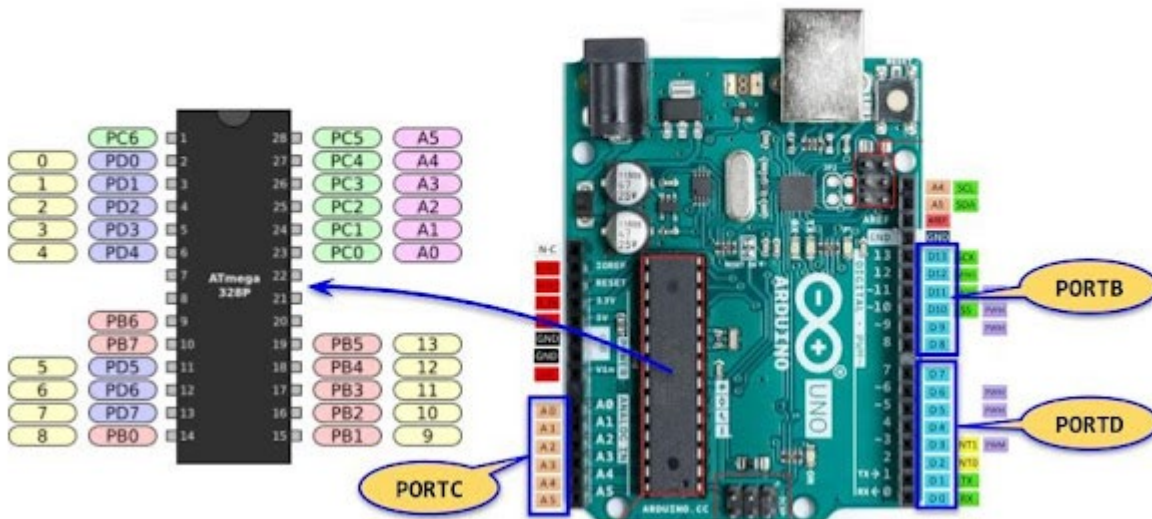
led.S



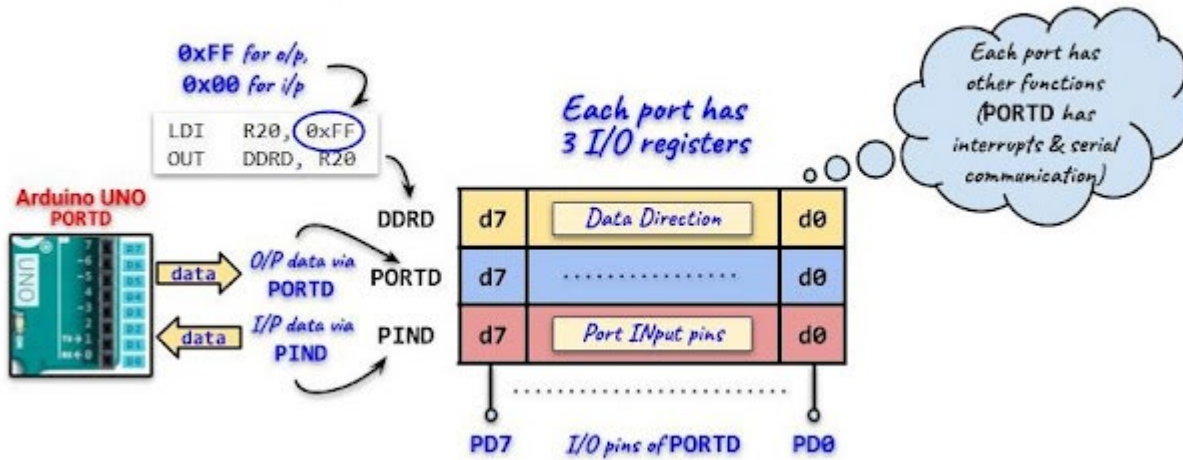
ATmega328P MCU Registers



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
```

```

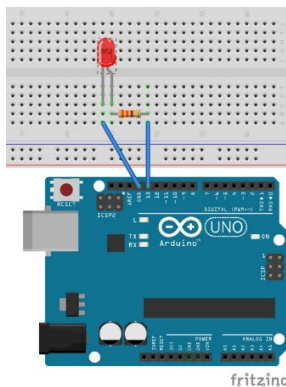
.global led
;-----
start:
    SBI  DDRB, 5      ;set PB5 (D13) as o/p
    RET              ;return to setup() function
;-----
led:
    CPI  R24, 0x00    ;value in R24 passed by caller compared with 0
    BREQ ledOFF      ;jump (branch) if equal to subroutine ledOFF
    SBI  PORTB, 5     ;set D13 to high
    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

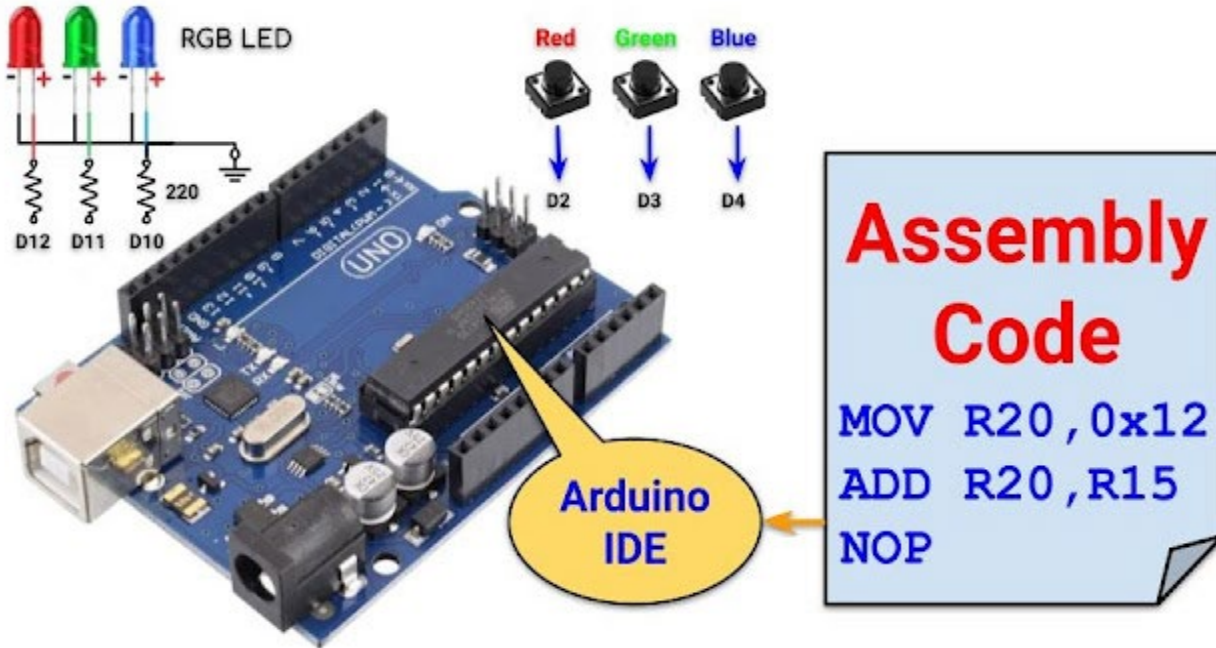
Experimental Setup:



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



.ino file:

```
//-----
// C Code: RGB LED ON/OFF via Buttons
//-----
extern "C"
{
    void start();
    void btnLED();
}
//-----
void setup()
{
    start();
}
//-----
void loop()
{
    btnLED();
}
```

.S file:

```
-----  
; Assembly Code: RGB LED ON/OFF via Buttons  
-----  
#define __SFR_OFFSET 0x00  
#include "avr/io.h"  
-----  
.global start  
.global btnLED  
=====
```

start:

SBI	DDRB, 4	;set PB4 (pin D12 as o/p - red LED)
SBI	DDRB, 3	;set PB3 (pin D11 as o/p - green LED)
SBI	DDRB, 2	;set PB2 (pin D10 as o/p - blue LED)
CBI	DDRD, 2	;clear PD2 (pin D02 as i/p - red button)
CBI	DDRD, 3	;clear PD3 (pin D03 as i/p - green button)

Questions for Report writing:

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