

# Computer Technology I

## Lab. 2: Subroutines



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#### 1 Task 1 - Switch - Ring counter / Johnson counter

Write a program which switch between Ring counter and Johnson counter. You should not use Interrupt in this lab. The pushbutton must be checked frequently, so there is no delay between the button is pressed and the change between Ring/Johnson. Use SWO (PAO) for the button. Each time you press the button, the program should change counter.

```
; 1DT301, Computer Technology I
; Date: 2016-09-15
; Author:
; Loic GALLAND
; Leonardo PEDRO
; Lab number: 2
; Title: Subroutines
; Hardware: STK600, CPU ATmega2560
; Function: Describe the function of the program, so that you can
   understand it,
; even if you're viewing this in a year from now!
; Input ports: Describe the function of used ports, for example on-
   board switches
; connected to PORTA.
; Output ports: Describe the function of used ports, for example on-
   board LEDs
; connected to PORTB.
; Subroutines: If applicable.
; Included files: m2560def.inc
; Changes in program: (Description and date)
.includes "m2560def.inc"
; Initialize SP, Stack Pointer
ldi r20, HIGH(RAMEND) ; R20 = high part of RAMEND address
out SPH,R20 ; SPH = high part of RAMEND address
ldi R20, low(RAMEND) ; R20 = low part of RAMEND address
out SPL,R20 ; SPL = low part of RAMEND address
ldi r16, 0xFF ; setting up the data direction register port B
out DDRB, r16 ; Set port B as output
ldi r16, 0x00
out DDRA, r16
ldi r24, 0b111111110
;ldi r25, 0b11111110
RC:
       ldi r21, Ob111111111; inital LED state
       out portB, r21
       mov r17, r21
```

```
ldi r22, 0xFF
        ldi r23, 0b111111110
        RC_loop:
                out portB, r17
                rol r17
                CALL Delay1
                in r25, PINA
                cp r25, r24
                breq JC
                cp r17, r22
                breq RC_light
        rjmp RC_loop
        RC_light:
                rol r17
                out portB, r17
                rjmp RC_loop
rjmp RC
JC:
        ldi r21, 0b11111110
        ldi r22, 0b11111111 ;desired one
        ldi r23, 0b00000000
        my_loop1:
                out portB, r21
                LSL r21
                CALL Delay1
                in r25, PINA
                cp r25, r24
                breq RC
                cp r21, r23 ; compare info with desired one
                breq light
        rjmp my_loop1
        light:
                out portB, r23
                CALL Delay1
                ldi r21, 0b10000000
                out portB, r21
                Second_loop:
                        in r25, PINA
                        cp r25, r24
                        breq RC
                        out portB, r21
                        ASR r21
                        CALL Delay1
                        cp r21, r22 ; compare info with desired one
                        breq my_loop
                rjmp Second_loop
rjmp JC
Delay1:
; Generated by delay loop calculator
; at http://www.bretmulvey.com/avrdelay.html
; Delay 1 950 500 cycles
; 500ms at 3.901 MHz
    ldi r18, 10
```

```
ldi r19, 230
ldi r20, 22
L1: dec r20
brne L1
dec r19
brne L1
dec r18
brne L1
RET
```

This is the flowchart of the task 1:

#### 2 Task 2 - Electronic dice

You should create an electronic dice. Think of the LEDs placed as in the picture below. The number 1 to 6 should be generated randomly. You could use the fact that the time you press the button varies in length.

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; connected to PORTB.
; Subroutines: If applicable.
; Included files: m2560def.inc
; Changes in program: (Description and date)
.include "m2560def.inc"
ldi r16, 0xFF ; setting up the data direction register port B
out DDRB, r16 ; Set port B as output
ldi r16,0x00
out DDRA, r16
ldi r19,1; counter
ldi r25, 0xFF
out PortB, r25
ldi r24,0b11111110
Listening_For_Switch_Press:
       in r17, PINA
       cp r17, r24
       breq loop
rjmp Listening_For_Switch_Press
```

```
Listening_For_Switch_Release:
        inc r19
        cpi r19,7
        breq reset
        in r17, PINA
        cp r17, r25
        breq RD
rjmp Listening_For_Switch_Release
reset:
ldi r19,1
rjmp Main
RD:
        cpi r19,1
        breq ONE
        cpi r19,2
        breq TWO
        cpi r19,3
        breq THREE
        cpi r19,4
        breq FOUR
        cpi r19,5
        breq FIVE
        cpi r19,6
        breq SIX
rjmp RD
ONE:
ldi r18,0b11101111
out PortB, r18
rjmp Listening_For_Switch_Press
TWO:
ldi r18,0b10111011
out PortB, r18
rjmp Listening_For_Switch_Press
THREE:
ldi r18,0b10101011
out PortB, r18
rjmp Listening_For_Switch_Press
FOUR:
ldi r18,0b00111001
out PortB, r18
rjmp Listening_For_Switch_Press
FIVE:
ldi r18,0b00101001
out PortB, r18
rjmp Listening_For_Switch_Press
SIX:
ldi r18,0b00010001
out PortB, r18
rjmp Listening_For_Switch_Press
```

This is the flowchart of the task 1:

#### 3 Task 3 - Change counter

Write a program that is able to count the number of changes on a switch. As a change we count when the switch SW0 goes from 0 to 1 and from 1 to 0, we expect therefore positive and negative edges. We calculate the changes in a byte variable and display its value on PORTB.

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  board LEDs
; connected to PORTB.
; Subroutines: If applicable.
; Included files: m2560def.inc
; Changes in program: (Description and date)
.include "m2560def.inc"
ldi r16, 0xFF ; setting up the data direction register port B
out DDRB, r16 ; Set port B as output
ldi r16,0x00
out DDRA, r16
ldi r25, 0
ldi r24,0
ldi r17, 0b11111111
out PORTB, r17
ldi r18, 0b11111110
my_loop:
```

```
in r19, PINA
        cp r18, r19
        breq counter
rjmp my_loop
counter:
inc r25
mov r20, r25
com r20
out portB, r20
         loop:
                 in r19,PINA
                 cp r19, r17
                breq counter2
        rjmp loop
counter2:
inc r25
mov r20, r25
com r20
out portB,r20
rjmp my_loop
```

#### 4 Task 4 - Delay subroutine with variable delay time

```
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   board switches
; connected to PORTA.
; Output ports: Describe the function of used ports, for example on-
  board LEDs
; connected to PORTB.
; Subroutines: If applicable.
; Included files: m2560def.inc
; Changes in program: (Description and date)
.include "m2560def.inc"
.equ INPUT= 1000
ldi r16, 0xFF ; setting up the data direction register port B
out DDRB, r16 ; Set port B as output
ldi r21, Ob111111111; inital LED state
out portB, r21
mov r17, r21
ldi r22, 0xFF
ldi r23, 0b11111110
RC_loop:
       out portB, r17
       rol r17
       CALL Delay
       cp r17, r22
       breq RC_light
rjmp RC_loop
RC_light:
       rol r17
       out portB, r17
       rjmp RC_loop
```

```
Delay:
        ldi r24, low(INPUT)
        ldi r25, high(INPUT)
        wait_milliseconds:
                call ms_delay
                sbiw r25:r24,1
                cpi r25, high(0)
                breq reset
        rjmp wait_milliseconds
reset:
RET
ms_delay:
       ; Generated by delay loop calculator
        ; at http://www.bretmulvey.com/avrdelay.html
        ; Delay 1 000 cycles
        ; 1ms at 1 MHz
        ldi r18, 2
        ldi r19, 75
L1: dec r19
        brne L1
        dec r18
brne L1
        rjmp PC+1
RET
```

This is the flowchart of the task 1: