Computer Technology I

Lab. 2 : Subroutines

Author: LOIC GALLAND,
LEONARDO PEDRO
Supervisor:
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Area: Computer Science
Course code: 1DT301

Contents

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 SW0 (PA0) 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   ;Set the data direction register port A
out DDRA, r16   ;Set portA as input

ldi r24, 0b11111110     ;Desired switch

RC:     ;Ring Counter Code
        ldi r21, 0b11111111; inital LED state
        out portB, r21  ;Turn off all the lights
        mov r17, r21    ;Copy r21 into r17
        ldi r22, 0xFF   ;To compare to make it restart when all the
```

```
            lights turn off
        RC_loop:
                out portB, r17  ;Show the corresponding lights
                rol r17 ;rotate the bits to make them go left
                CALL Delay1     ;Delay of 0.5 seconds
                in r25, PINA    ;Read the input from the switch
                cp r25,r24      ;Compare the switches with the desired
                    switch
                breq JC ;If they are =, go to Johnson Counter
                cp r17, r22             ;Check if all the lights are
                    turned off
                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

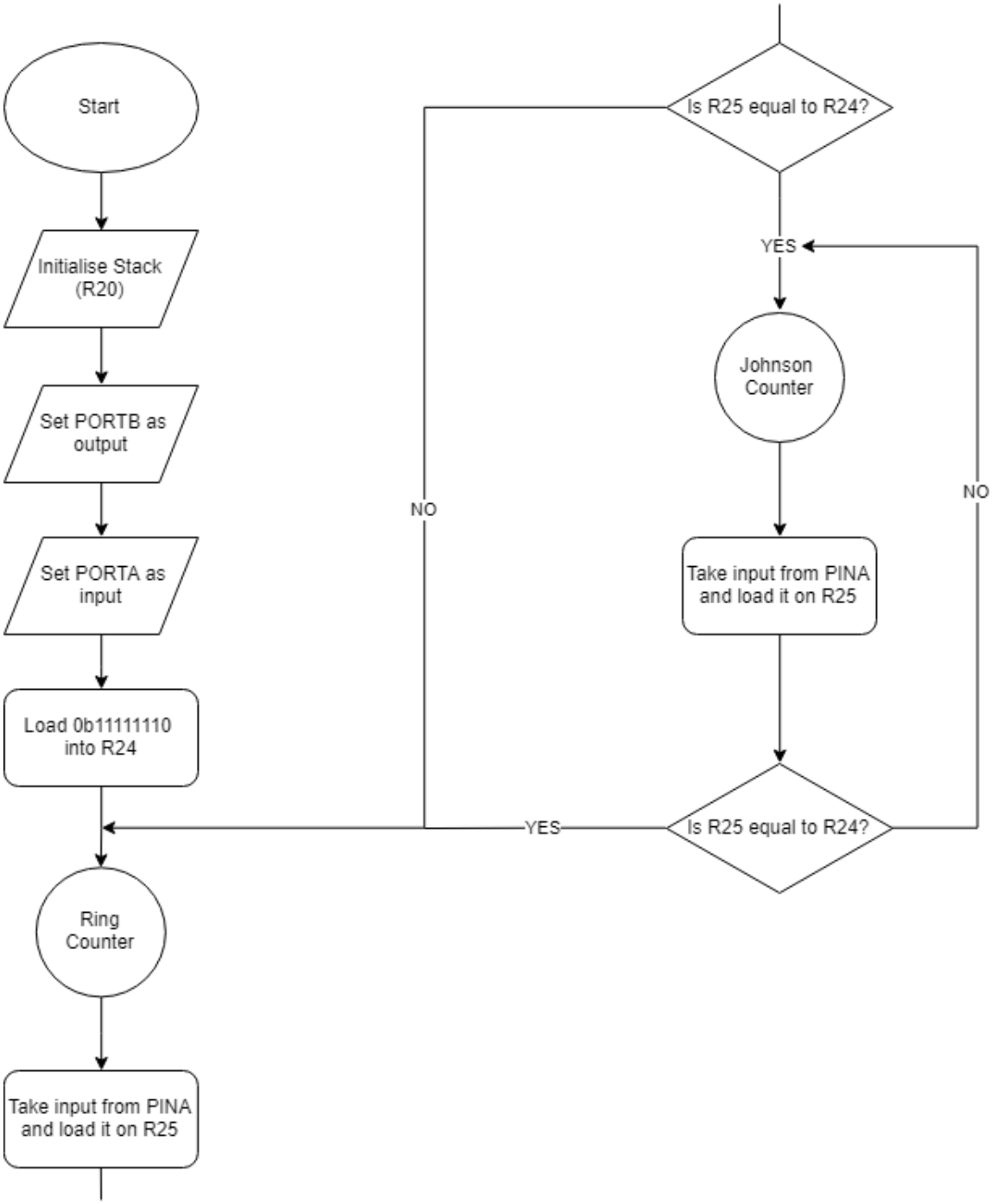
        light:
                out portB, r23
                CALL Delay1
                ldi r21, 0b10000000
                out portB, r21
                Second_loop:
                        in r25, PINA
                        cp r25,r24
                        breq RC
                        out portB, 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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.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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.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
```

This is the flowchart of the task 3:

4 Task 4 - Delay subroutine with variable delay time

```
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;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
.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, 0b11111111; 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: