Computer Technology

Report for Lab 2

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Semester: HT2018
Area: Computer Technology
Course code: 1DV607

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1 Task 1

Switch - Ring counter / Johnson counter

1.1 Diagram

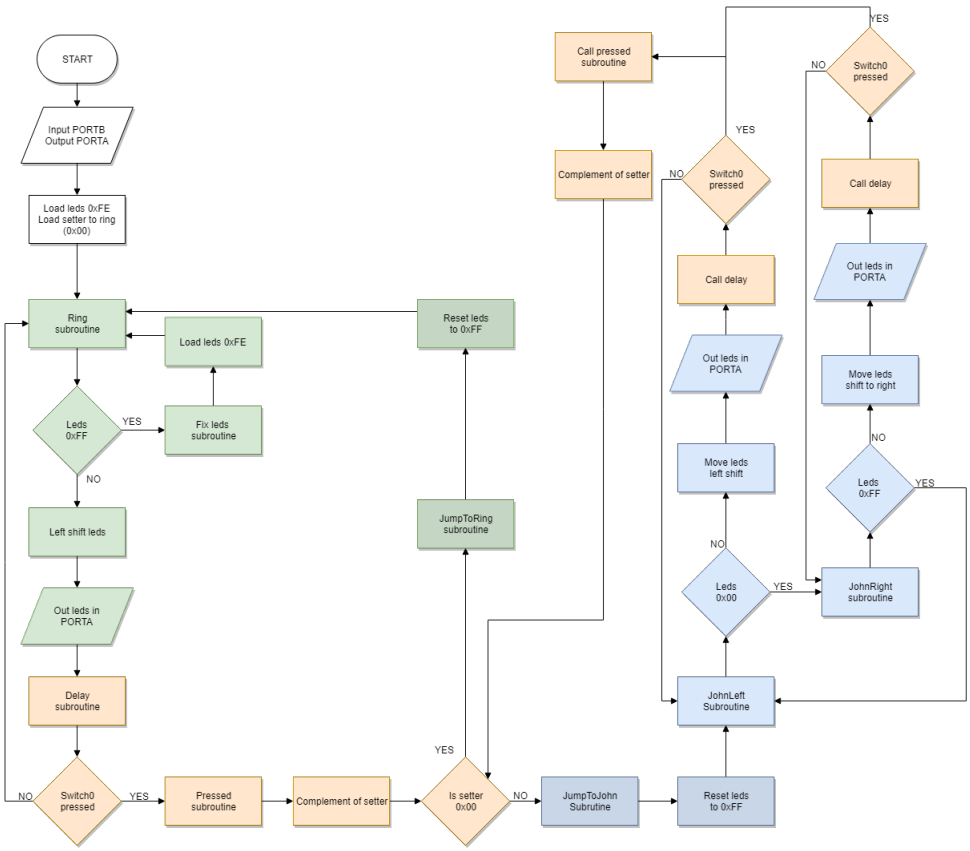

Figure 1: Task 1 diagram

1.2 Code

Listing 1: Task 1 code.

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2018-09-24
; Author:
; Jiahui Le (jl224bn)
;     Helena Tevar (ht222fd)
;
; Lab number: 2
; Title: Ring counter / Johnson counter
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Changes the led display from Ring counter to
;     Johnson counter, by pressing switch 0
;
; Input ports: PORTA
;
; Output ports: PORTB
;
; Subroutines: Delay 500ms
;
; Included files: m2560def.inc
;
; Other information: Changed code from Lab 1 after
;     encountering problems with
;     command rol and asr and delay
;
; Changes in program:
;     224/09/2018
;     Implementation on board successfully
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

.include "m2560def.inc"
.def leds = r16
.def setter = r22

;-----------------------------
; Initialize SP, Stack Pointer
;-----------------------------
ldi r20, HIGH(RAMEND)
out SPH,r20
ldi R20, low(RAMEND)
out SPL,R20

;-----------------------------
; setting input/output
;-----------------------------
ldi r20, 0xFF
```

```
out DDRB, r20
ldi r23, 0x00
out DDRA, r23

;-----------------------
; load leds
;-----------------------
ldi leds, 0xFE



ldi setter, 0x00

ring:

        cpi leds, 0xFF
        breq fixLedsOff

        out PORTB, leds
        com leds
        lsl leds
        com leds
        rcall delay
        rjmp ring

        fixLedsOff:
                ldi leds, 0xFE
                rjmp ring


;-----------------------
;Johnson Counter
;Fixed without asr
;-----------------------
johnson_on:

        cpi leds, 0x00
        breq johnson_off

        out PORTB, leds
        lsl leds
        rcall delay
        rjmp johnson_on

johnson_off:
        out PORTB, leds
        cpi leds, 0xFF
        breq johnson_on
        com leds
        lsr leds
        com leds
        rcall delay
```

```
        rjmp johnson_off

pressed:
        com setter
        cpi setter,0x00
        breq reset_ring
        rjmp reset_john

;−−−−−−−−−−−−−−−−−−−−−−−−
; subroutines to change
; from ring to john
;−−−−−−−−−−−−−−−−−−−−−−−−
reset_ring:
        ldi leds, 0xFF
        out PORTB, leds
        rjmp ring

reset_john:
        ldi leds, 0xFF
        out PORTB, leds
        rjmp johnson_on



; Generated by delay loop calculator
; at http://www.bretmulvey.com/avrdelay.html
;
; Delay 500 000 cycles
; 500ms at 1 MHz

delay:
        ldi r18, 3
    ldi r19, 138
    ldi r21, 86
L1: dec r21
    brne L1
        dec r19
    brne L1
    dec r18
    brne L1


        in r23, PINA
        cpi r23, 0xFE
        breq pressed

    rjmp PC+1

ret
```

2 Task 2

Electronic dice

2.1 Diagram

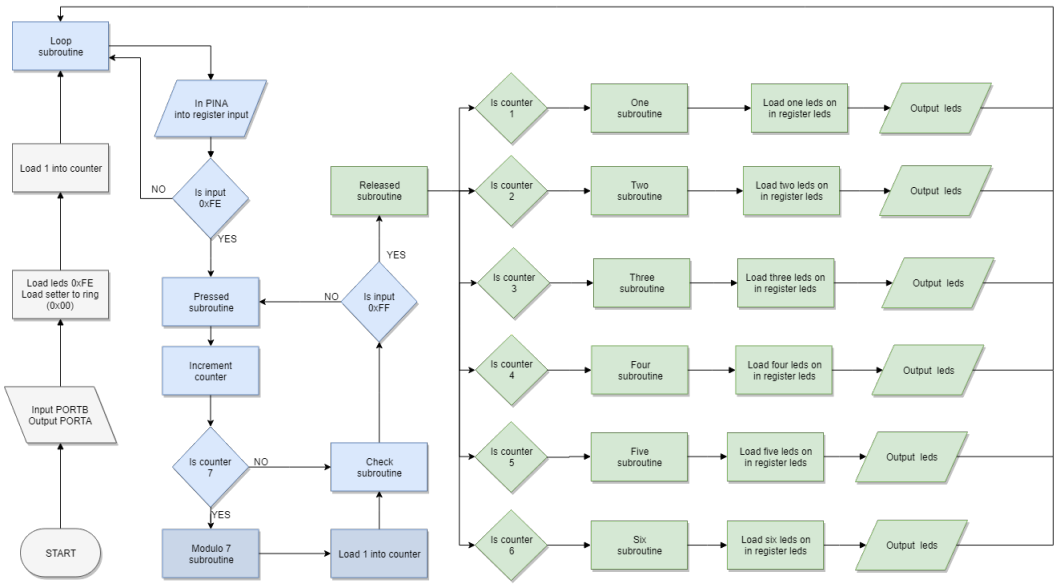

Figure 2: Task 2 diagram

2.2 Code

Listing 2: Task 2 code.

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2018-09-24
; Author:
; Jiahui Le (jl224bn)
;     Helena Tevar (ht222fd)
;
; Lab number: 2
; Title: Electronic Dice
;
; Hardware: STK600, CPU ATmega2560
;
; Function: A counter keeps adding numbers and pick one "randomly"
;
; Input ports: PORTA
;
; Output ports: PORTB
;
; Subroutines: loop - looping program
;     modulo6 - divides counter by 6
;     output - picks a number
;     <<numbers>>
;
; Included files: m2560def.inc
;
; Other information:
;
; Changes in program:
;     224/09/2018
;     Implementation on board succesfully
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
.include "m2560def.inc"

.def settings = r16
.def leds = r17
.def input = r18
.def counter = r19



;-----------------------
; Setting I/O ports
;-----------------------
ldi settings, 0xFF
out DDRB, settings

ldi settings, 0x00
out DDRA, settings
;-----------------------
```

```
; Start dice with 1
;-----------------------
ldi counter,1

;-----------------------
; Dice loop
;-----------------------
loop:
in input, PINA
cpi input, 0xFE
breq pressed
rjmp loop


;-----------------------
; When pressing switch
;-----------------------
pressed:
inc counter
cpi counter, 7
breq modulo6

check:
in input, PINA
cpi input, 0xFF
breq output

rjmp pressed

;-----------------------
; Modulo 6
; turn counter 7 to 1
;-----------------------
modulo6:
ldi counter, 1
rjmp check

;-----------------------
; Output result
;-----------------------

output:
cpi counter, 1
breq one

cpi counter, 2
breq two

cpi counter, 3
breq three

cpi counter, 4
```

```
breq four

cpi counter, 5
breq five

cpi counter, 6
breq six

;−−−−−−−−−−−−−−−−−−−−−−−−
; Output leds
;−−−−−−−−−−−−−−−−−−−−−−−−
one:
ldi leds, 0b0001_0000
out DDRB, leds
rjmp loop

two:
ldi leds, 0b0100_0100
out DDRB, leds
rjmp loop

three:
ldi leds, 0b0101_0100
out DDRB, leds
rjmp loop

four:
ldi leds, 0b1100_0110
out DDRB, leds
rjmp loop

five:
ldi leds, 0b1101_0110
out DDRB, leds
rjmp loop

six:
ldi leds, 0b1110_1110
out DDRB, leds
rjmp loop
```

3 Task 3

Change counter

3.1 Diagram

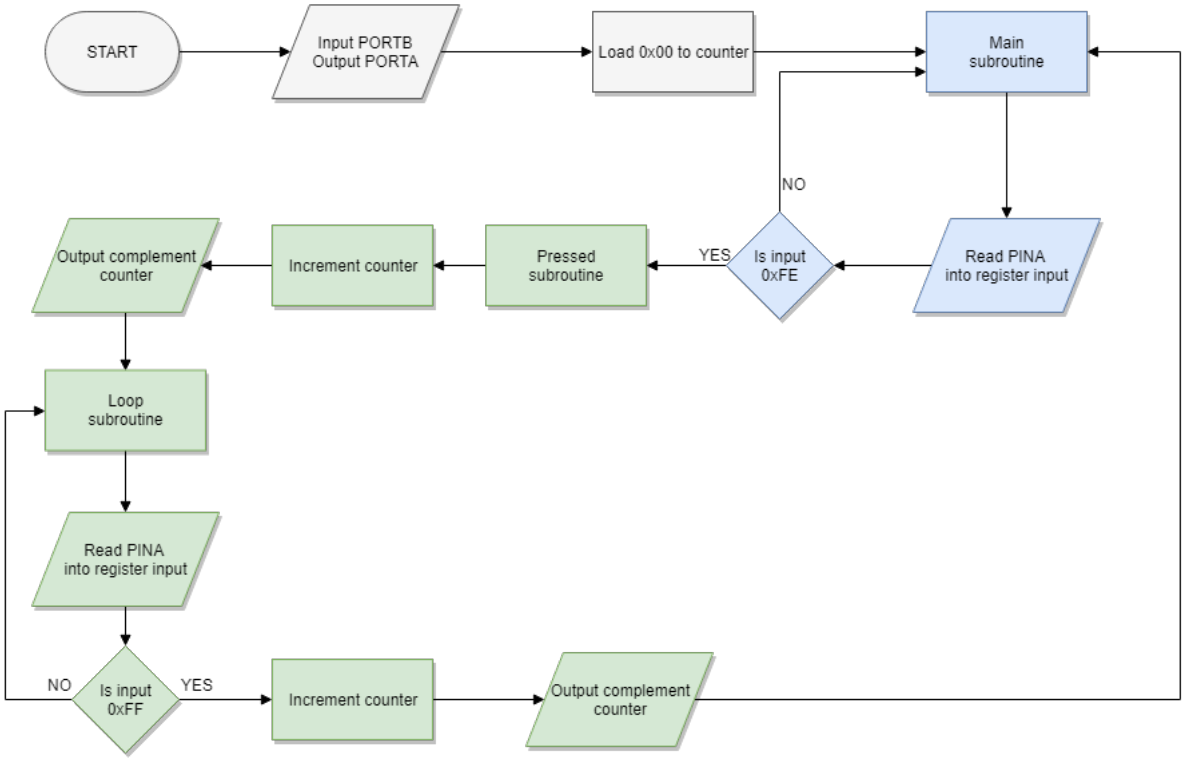

Figure 3: Task 3 diagram

3.2 Code

Listing 3: Task 3 code.

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2018-09-24
; Author:
; Jiahui Le (jl224bn)
;     Helena Tevar (ht222fd)
;
; Lab number: 2
; Title: Change counter
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Shows the binary number of a counter
;     that records the number of changes of switch0
;
; Input ports: PORTA
;
; Output ports: PORTB
;
; Subroutines: main  - Main loop waits for switch pressed
;     pressed  - Subroutine when switch is pressed
;     loop  - Loop waiting for switch release
;
; Included files: m2560def.inc
;
; Other information:
;
; Changes in program:
;     24/09/2018
;     Implementation on board successfully
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
.include "m2560def.inc"
.def settings = r16
.def counter = r17
.def input = r18

;-----------------------
; Setting I/O ports
;-----------------------
ldi settings, 0x00
out DDRA, settings
ldi settings, 0xff
out DDRB, settings


ldi counter, 0x00
```

```
;−−−−−−−−−−−−−−−−−−−−−−−−
; Main:
; Waits for switch
;−−−−−−−−−−−−−−−−−−−−−−−−
main:
        in input, PINA
        cpi input, 0xFE
        breq pressed
rjmp main

;−−−−−−−−−−−−−−−−−−−−−−−−
; Pressed:
; increments and shows
; leds of counter
;−−−−−−−−−−−−−−−−−−−−−−−−
pressed:    ;
        inc counter
        com counter
        out PORTB, counter
        com counter
;−−−−−−−−−−−−−−−−−−−−−−−−
; loop:
; Waits switch release
; increments and shows
; leds of counter
;−−−−−−−−−−−−−−−−−−−−−−−−
loop:
        in input, PINA
        cpi input, 0xFF
        brne loop

        inc counter
        com counter
        out PORTB, counter
        com counter
rjmp main
```

4 Task 4

Delay subroutine with variable delay time

4.1 Diagram

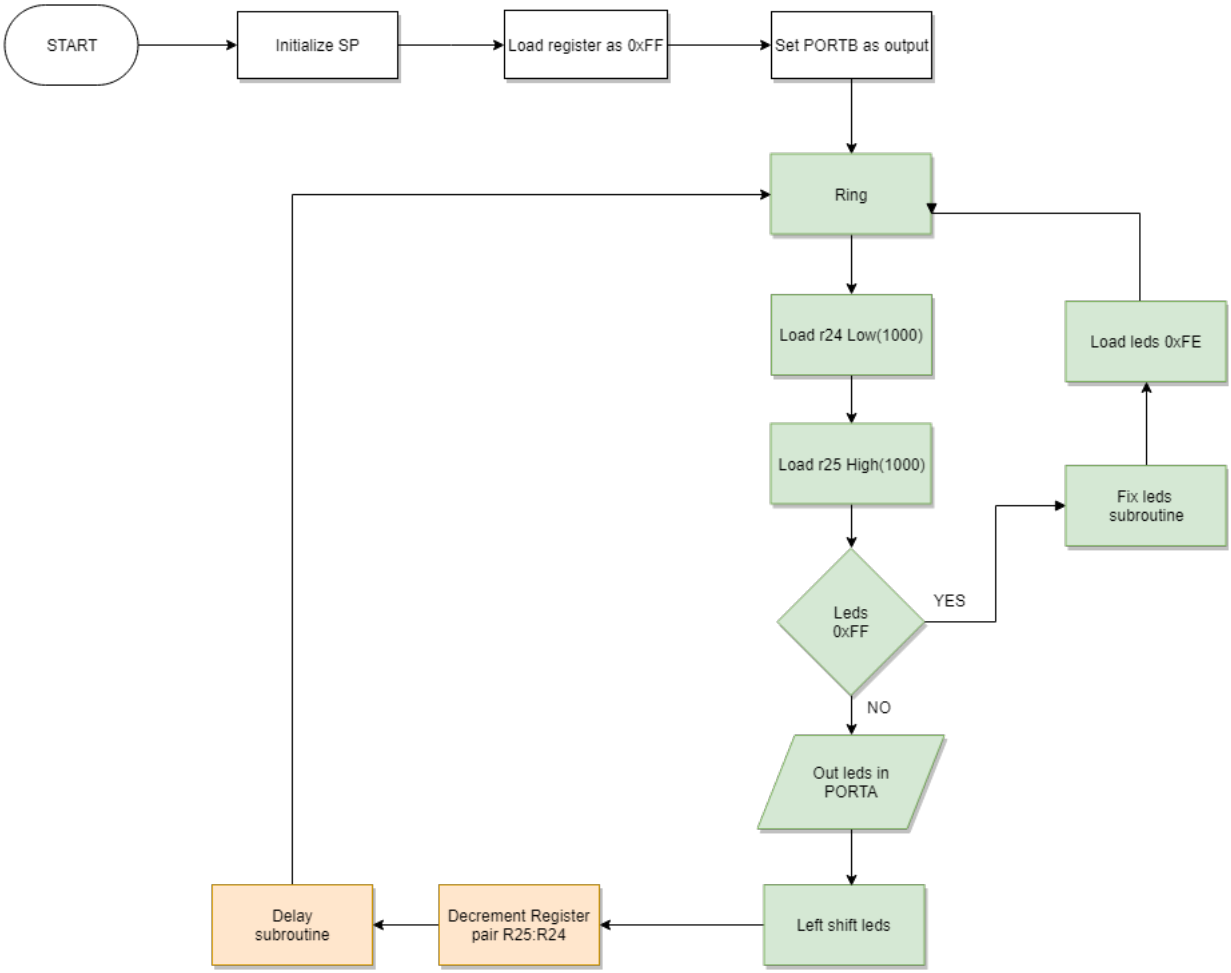

Figure 4: Task 4 diagram

4.2 Code

Listing 4: Task 4 code.

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2018-09-24
; Author:
; Jiahui Le (jl224bn)
;     Helena Tevar (ht222fd)
;
; Lab number: 2
; Title: Delay subroutine with variable delay time
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Lab 1 task 5 modified to create a variable delay
;
; Input ports:
;
; Output ports: PORTB
;
; Subroutines:
;
; Included files: m2560def.inc
;
; Other information:
;
; Changes in program:
;     24/09/2018
;     Implementation on board successfully
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
.include "m2560def.inc"
.def leds = r16
.def setting = r17

;-----------------------
; Initialize Stack
;-----------------------
ldi r20, HIGH(RAMEND)
out SPH, R20
ldi R20, low(RAMEND)
out SPL, R20

;-----------------------
; Setting I/O ports
;-----------------------
ldi setting, 0xFF
out DDRB, setting
;Starting with leds off
ldi leds, 0xFF
```

```
;−−−−−−−−−−−−−−−−−−−−−−
; Ring counter
;−−−−−−−−−−−−−−−−−−−−−−
main:
        ring:
                ldi r24, LOW(1000)
                ldi r25, HIGH(1000)

                cpi leds, 0xFF     ;Check if leds are off
                breq fixLedsOff

                out PORTB, leds

                com leds      ;Moving leds
                lsl leds
                com leds

                rcall wait_milliseconds
        rjmp ring

        fixLedsOff:
        ldi leds, 0xFE

rjmp main
;−−−−−−−−−−−−−−−−−−−−−−
; Wait milliseconds
; subtract 1 to pair
; r25:r24
;−−−−−−−−−−−−−−−−−−−−−−
wait_milliseconds:
        sbiw r25:r24,1
        brne delay

;−−−−−−−−−−−−−−−−−−−−−−
; Delay from delay calculator
;−−−−−−−−−−−−−−−−−−−−−−
delay:
        ldi r18, 6
    ldi r19, 19
    ldi r21, 174
L1: dec r21
    brne L1
    dec r19
    brne L1
    dec r18
    brne L1
    rjmp PC+1

ret
```