

Microprocessor Lab Experiment 3

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1 Controlling LED with switch

1.1 Algorithm for the problem:

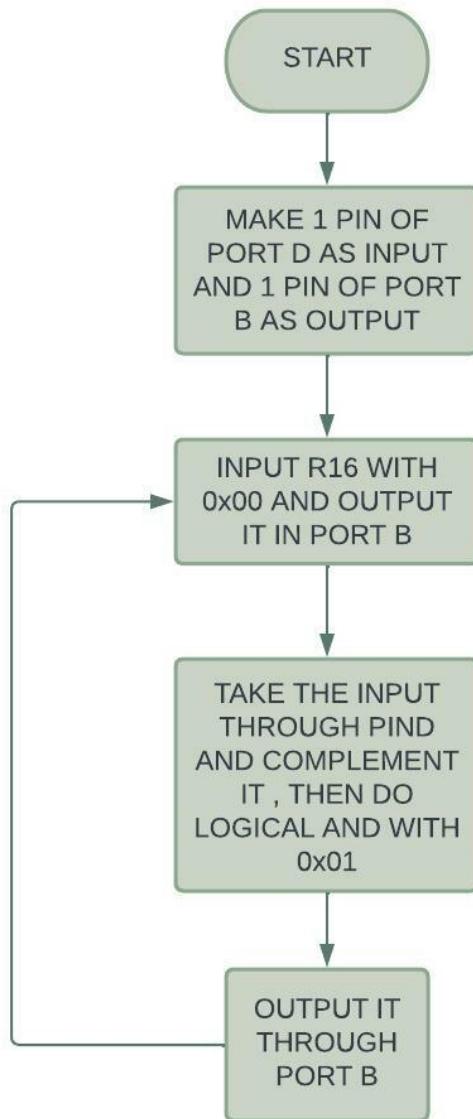


Figure 1: Flowchart for controlling LED using switch

1.2 Code:

```
.CSEG
LDI R16,0x01
OUT DDRB, R16

LDI R16,0x00
OUT DDRD, R16

again: LDI R16,0x00
      OUT PORTB, R16

      IN R16, PIND
      COM R16
      ANDI R16, 0x01
      OUT PORTB, R16
      RJMP again
```

1.3 Output:

[Video of LED controlled by switch made by my teammate and me.](#)

2 4 bit Addition

2.1 Algorithm for the problem

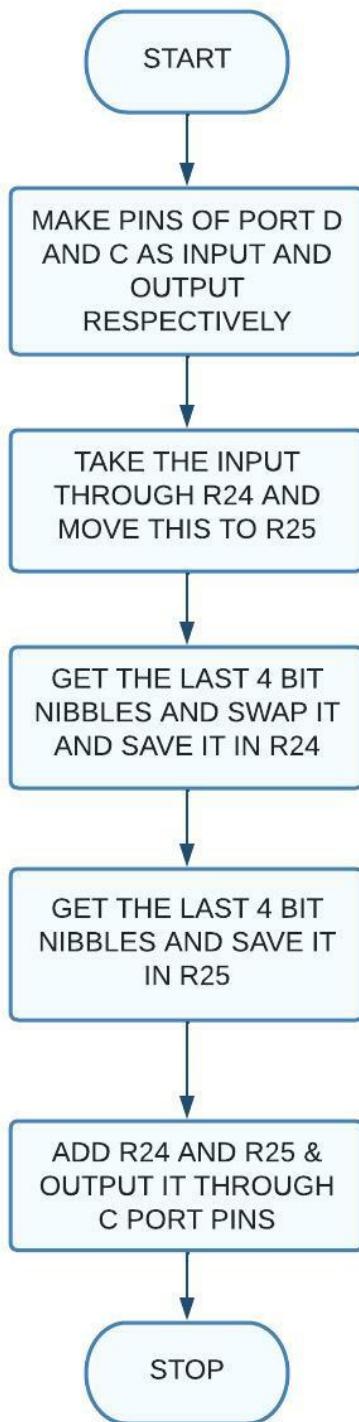


Figure 2: Flowchart for the addition of two nibbles

2.2 Code:

```
#include "m8def.inc"
LDI R16, 0x00;
OUT DDRD, R16; Setting PORTD to INPUT

LDI R16, 0xFF;
OUT DDRC, R16; Setting PORTC to OUTPUT

IN R24, PIND; R24 <- (<NUM2><NUM1>)
MOV R25, R24; Making copy of R24 in R25 for having the 2 numbers in separate registers
ANDI R24, 0xF0; Assigning R24 as "<NUM2>0000"
SWAP R24; Swapping higher and lower nibble
ANDI R25, 0x0F; Assigning R25 as "0000<NUM1>"
ADD R24, R25; R20 <- R24 + R25

OUT PORTC, R24; PORTD <- R24
NOP; End of program
```

2.3 Output:

- $1001 + 0111 = 10000$
- $1101 + 0111 = 10100$

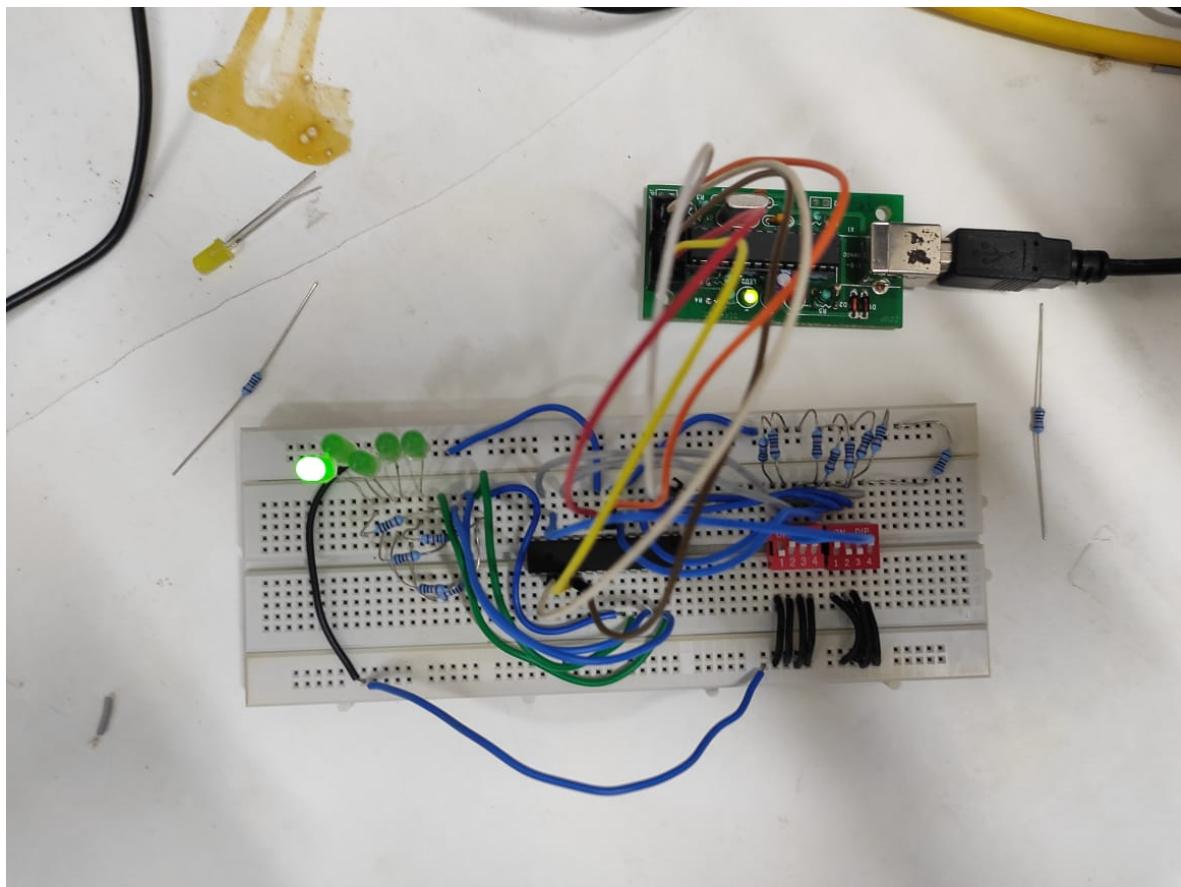


Figure 3: Result of the addition of 1001 and 0111

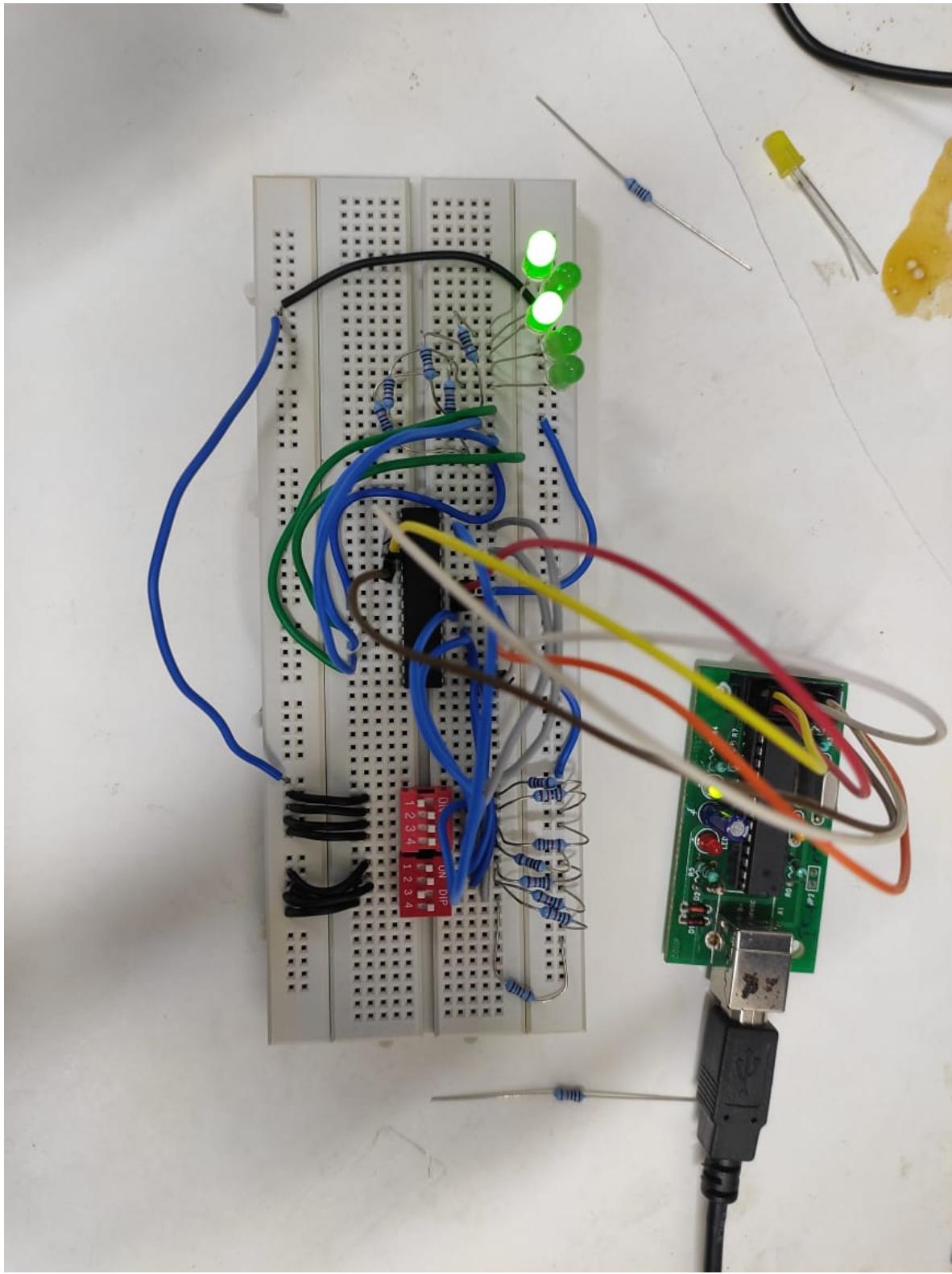


Figure 4: Result of the addition of 1101 and 0111

3 4 bit Multiplication

3.1 Algorithm for the problem



Figure 5: Flowchart for multiplication of two nibbles

3.2 Code:

```
#include "m8def.inc"

LDI R16, 0x00
OUT DDRD, R16 //we will use PORT D as INPUT
LDI R16, 0xFF
OUT DDRC, R16 //We will use PORT C as OUTPUT
LDI R16, 0xF0
OUT DDRB, R16
IN R21, PIND
COM R21
MOV R22, R21
ANDI R21, 0xF0
SWAP R21
ANDI R22, 0x0F
MUL R21,R22
MOV R20, R0
OUT PORTC, R20
OUT PORTB, R20
NOP
```

3.3 Output:

- $1001 * 0111 = 00111111$
- $1100 * 1111 = 10110100$

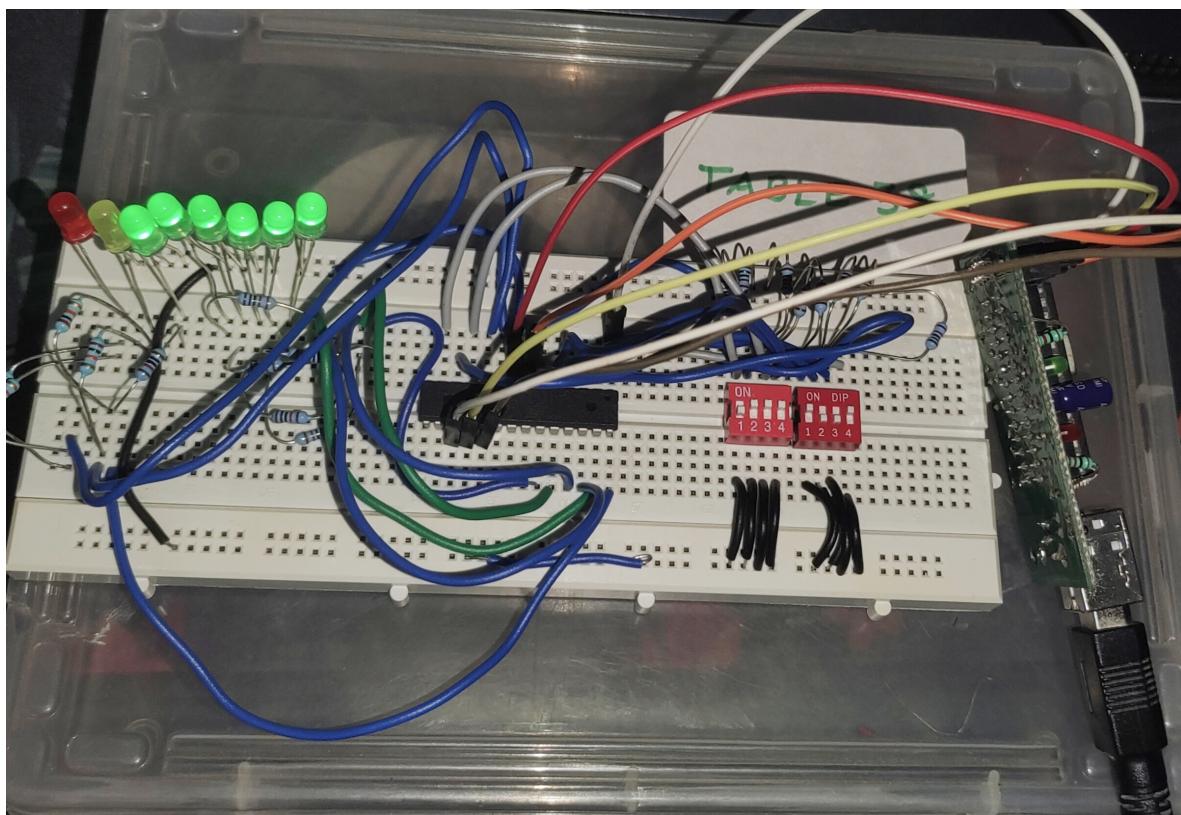


Figure 6: Result of the multiplication of 1001 and 0111

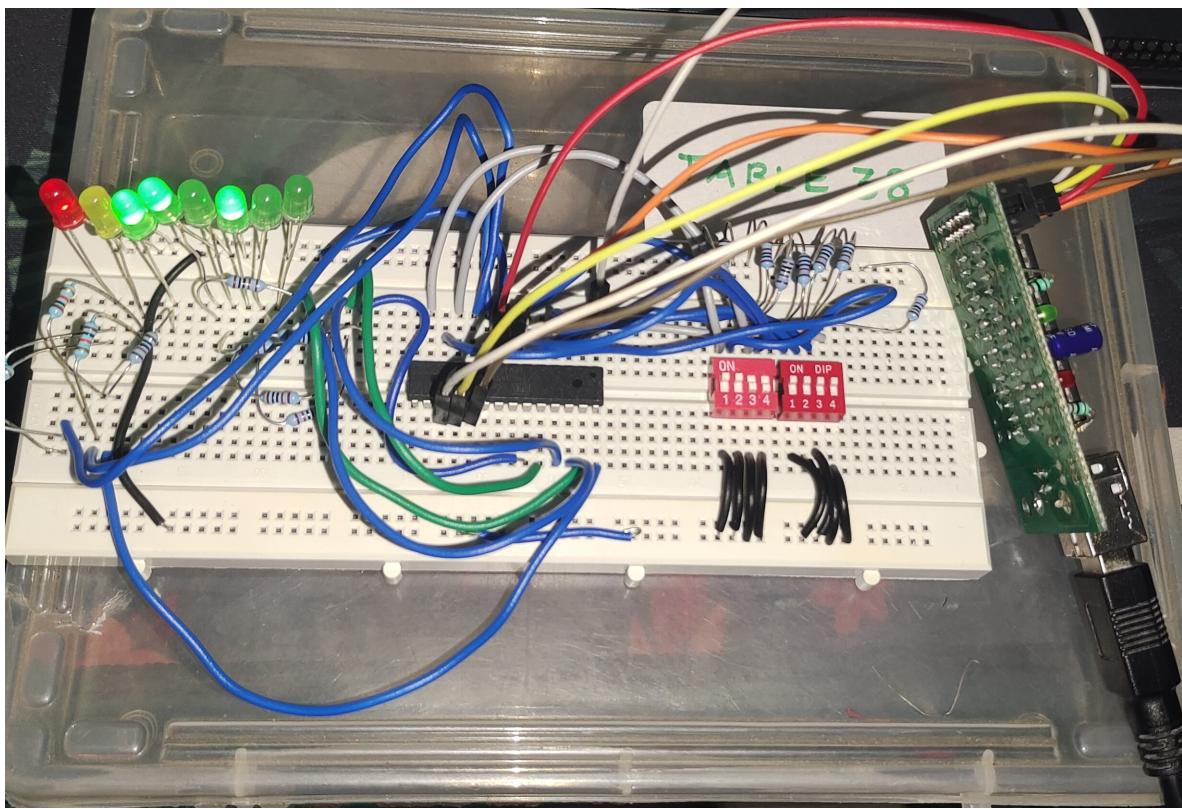


Figure 7: Result of the multiplication of 1100 and 1111