Communication and Computer Engineering Department

Shoubra Faculty of Engineering

Benha University

Embedded Systems
“Summer Training Report”

Made by

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B.N.: **8**

a) PIC16f877A Pins Description

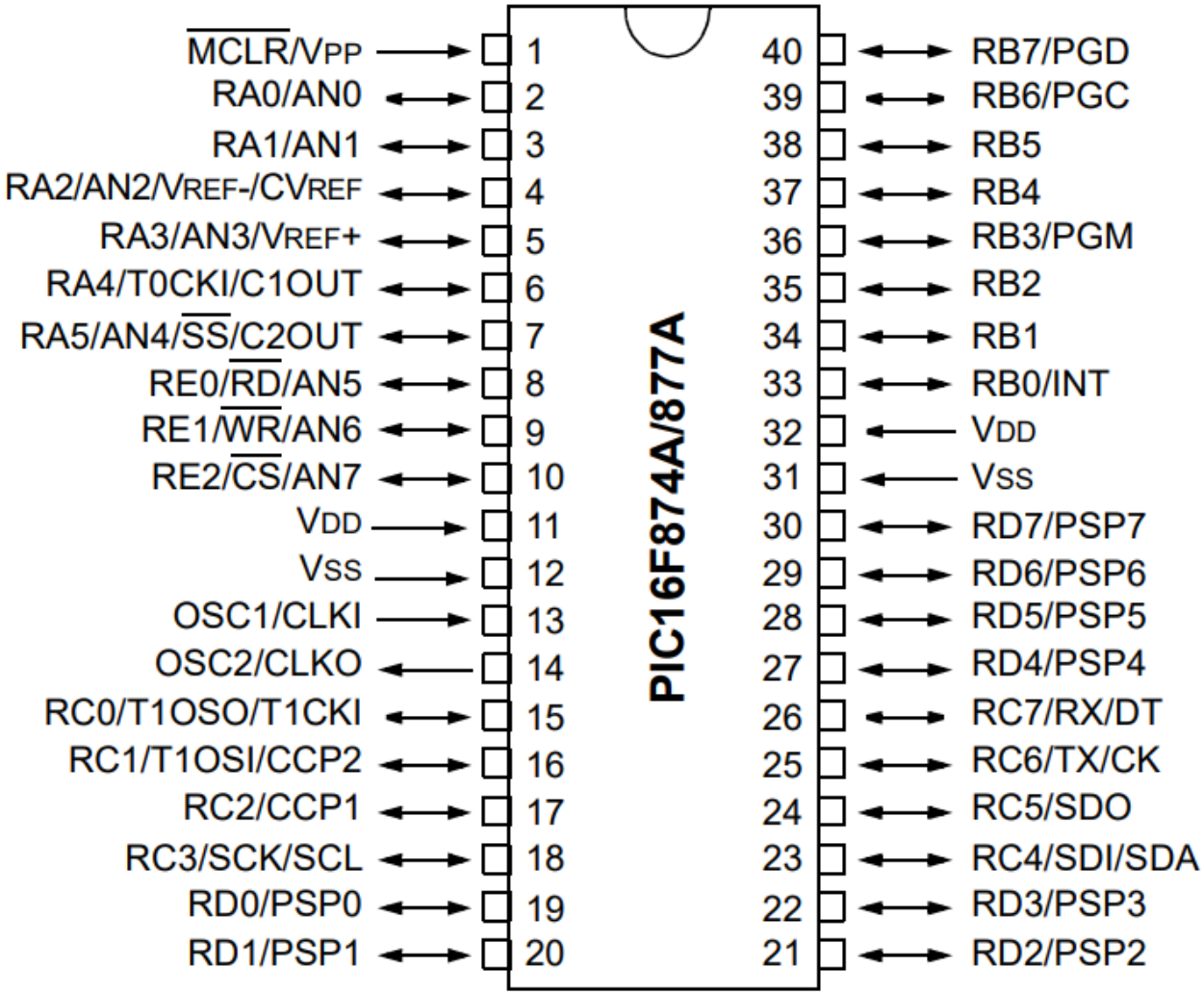


Figure 1 : PIC16f877A PINS

I. Individual Pins

Name	Pin No.	I/O/P Type	Function
MCLR	1	I	Master Clear (**Reset**) input. This pin is an active low reset to the device.
V_{DD}	11, 32	P	Positive supply for logic and I/O pins.
V_{SS}	12, 31	P	Ground reference for logic and I/O pins
OSC1	13	I	Oscillator crystal input or external clock source input.
OSC2	14	O	Oscillator crystal output.

II. Port A: 6 Pins (-, -, A5, A4, A3, A2, A1, A0)

❖ *The two bits on the far left of this register are not used.*

Name	Pin No.	I/O/P Type	Function
RA0/AN0 RA0 AN0	2	 I/O I	 Digital I/O. Analog input 0.
RA1/AN1 RA1 AN1	3	 I/O I	 Digital I/O. Analog input 1
RA2/AN2 RA2 AN2	4	 I/O I	 Digital I/O. Analog input 2.
RA3/AN3 RA3 AN3	5	 I/O I	 Digital I/O. Analog input 3.
RA4	6	I/O	Digital I/O – **Open-drain when configured as output.**
RA5/AN4 RA5 AN4	7	 I/O I	 Digital I/O. Analog input 4.

III. Port B: 8 Pins (B7, B6, B5, B4, B3, B2, B1, B0)

- *PORTB can be software programmed for internal weak pull-up on all inputs.*

Name	Pin No.	I/O/P Type	Function
RB0/INT RB0 INT	33	I/O I	Digital I/O. **External interrupt.**
RB1	34	I/O	Digital I/O.
RB2	35	I/O	Digital I/O.
RB3	36	I/O	Digital I/O.
RB4	37	I/O	Digital I/O.
RB5	38	I/O	Digital I/O.
RB6	39	I/O	Digital I/O.
RB7	40	I/O	Digital I/O.

IV. Port C: 8 Pins (C7, C6, C5, C4, C3, C2, C1, C0)

Name	Pin No.	I/O/P Type	Function
RC0	15	I/O	Digital I/O.
RC1	16	I/O	Digital I/O.
RC2	17	I/O	Digital I/O.
RC3	18	I/O	Digital I/O.
RC4	23	I/O	Digital I/O.
RC5	24	I/O	Digital I/O.
RC6	25	I/O	Digital I/O.
RC7	26	I/O	Digital I/O.

V. Port D: 8 Pins (D7, D6, D5, D4, D3, D2, D1, D0)

Name	Pin No.	I/O/P Type	Function
RD0	19	I/O	Digital I/O.
RD1	20	I/O	Digital I/O.
RD2	21	I/O	Digital I/O.

RD3	22	I/O	Digital I/O.
RD4	27	I/O	Digital I/O.
RD5	28	I/O	Digital I/O.
RD6	29	I/O	Digital I/O.
RD7	30	I/O	Digital I/O.

VI. Port E: 8 Pins (-, -, -, -, -, E2, E1, E0)

- *The five bits on the far left of this register are not used.*

Name	Pin No.	I/O/P Type	Function
RE0/AN5 RE0 AN5	8	 I/O I	 Digital I/O. Analog input 5.
RE1/AN6 RE1 AN6	9	 I/O I	 Digital I/O. Analog input 6.
RE2/AN7 RE2 AN7	10	 I/O I	 Digital I/O. Analog input 7

- *Maximum current sunk or sourced by PORTA, PORTB and PORTE (**combined**) is **200 mA**.*
- *Maximum current sunk or sourced by PORTC and PORTD (**combined**) is **200 mA**.*

b) The Functions of The Main Blocks in PIC16f877A

Block Name	Functions
ALU	The Arithmetic Logic Unit (ALU) is the computational brain of the microcontroller. It performs arithmetic and logical operations on data. Arithmetic operations such as: addition, subtraction, multiplication, division, increment and decrement. Logical operations such as: AND, OR, XOR, NOT, Shift, Rotate.
Status and Control	Status Register: Stores information about the **current state** of the microcontroller. Used for decision-making in the program. Control Register: Controls the **behavior** of the microcontroller and sets up peripherals. It controls interrupt priorities. It determines operating modes (e.g., sleep, low-power).
Program Counter	This block is a register that stores the **address of the next instruction** to be executed. The program counter is the microcontroller's roadmap, guiding it through the sequence of instructions in the program.
Flash Program Memory	The Flash program memory is the non-volatile storage area. This block is where the program code is stored. The program remains intact even when the power is turned off. It can be erased and reprogrammed multiple times.
Instruction Register	This block is a register that holds the current instruction being executed. It acts as a **short-term memory**.
Instruction Decoder.	This block decodes the instruction held in the Instruction Register and generates the appropriate control signals to execute the instruction. It acts as a **translator**, converting the machine code into actions that the microcontroller can understand and perform.

c) Why a led, which is connected to RA4 for flashing prepose is not working probably?

Any pin has internally two transistors (as shown in **figure 2** below). If the pin has been set to logic 0, the upper transistor will be open circuit and the lower one will be short circuit so the pin will be connected to the ground. On the other hand, if the pin has been set to logic 1, the upper transistor will be short circuit and the lower one will be open circuit so the pin will be connected to the V_{DD}.

In case of RA4, the upper part is not existing (as shown in **figure 3** below). RA4 is open-drain when configured as output. That means RA4 can be used properly for flashing prepose if **only** it is set to logic 0 and is input (connected as **sunk**).

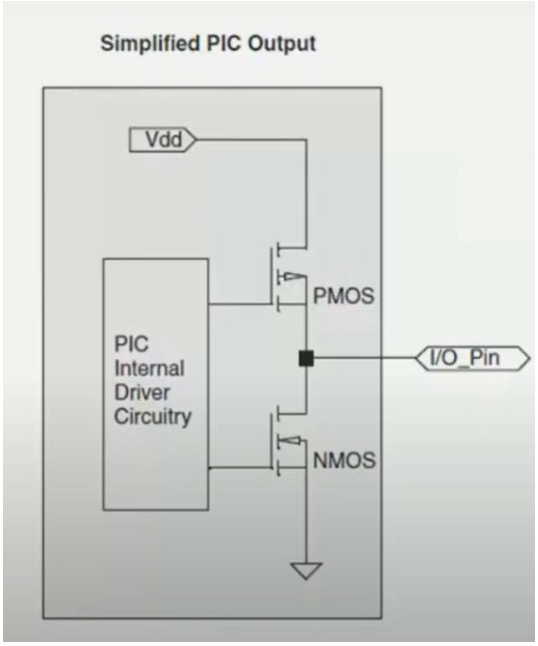


Figure 2

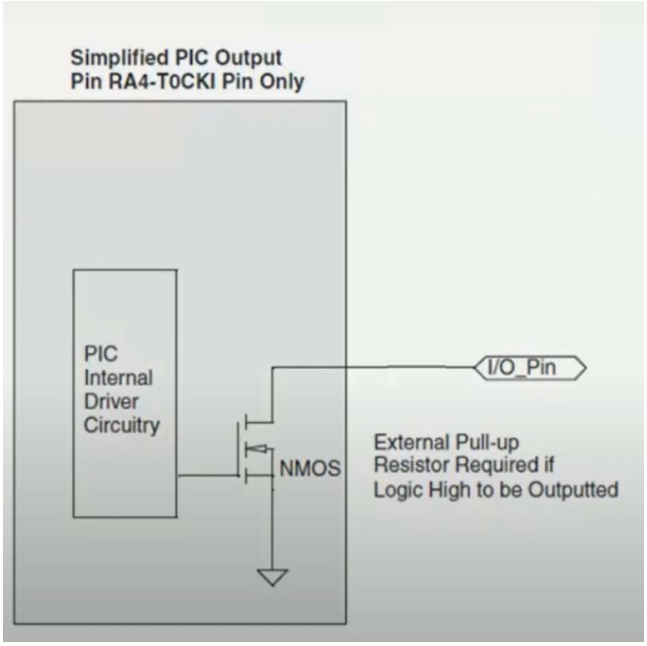


Figure 3

d) ATMega328P VS PIC16f877A

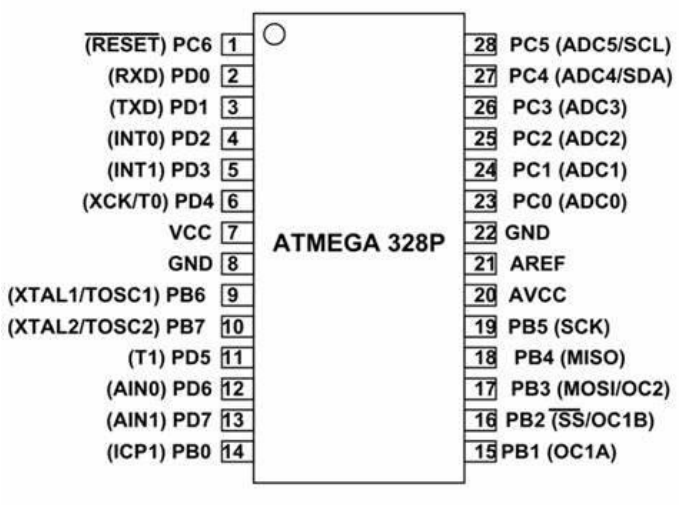


Figure 4

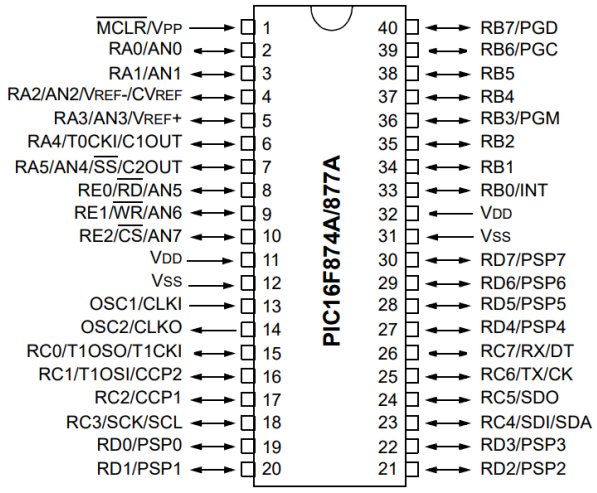


Figure 5

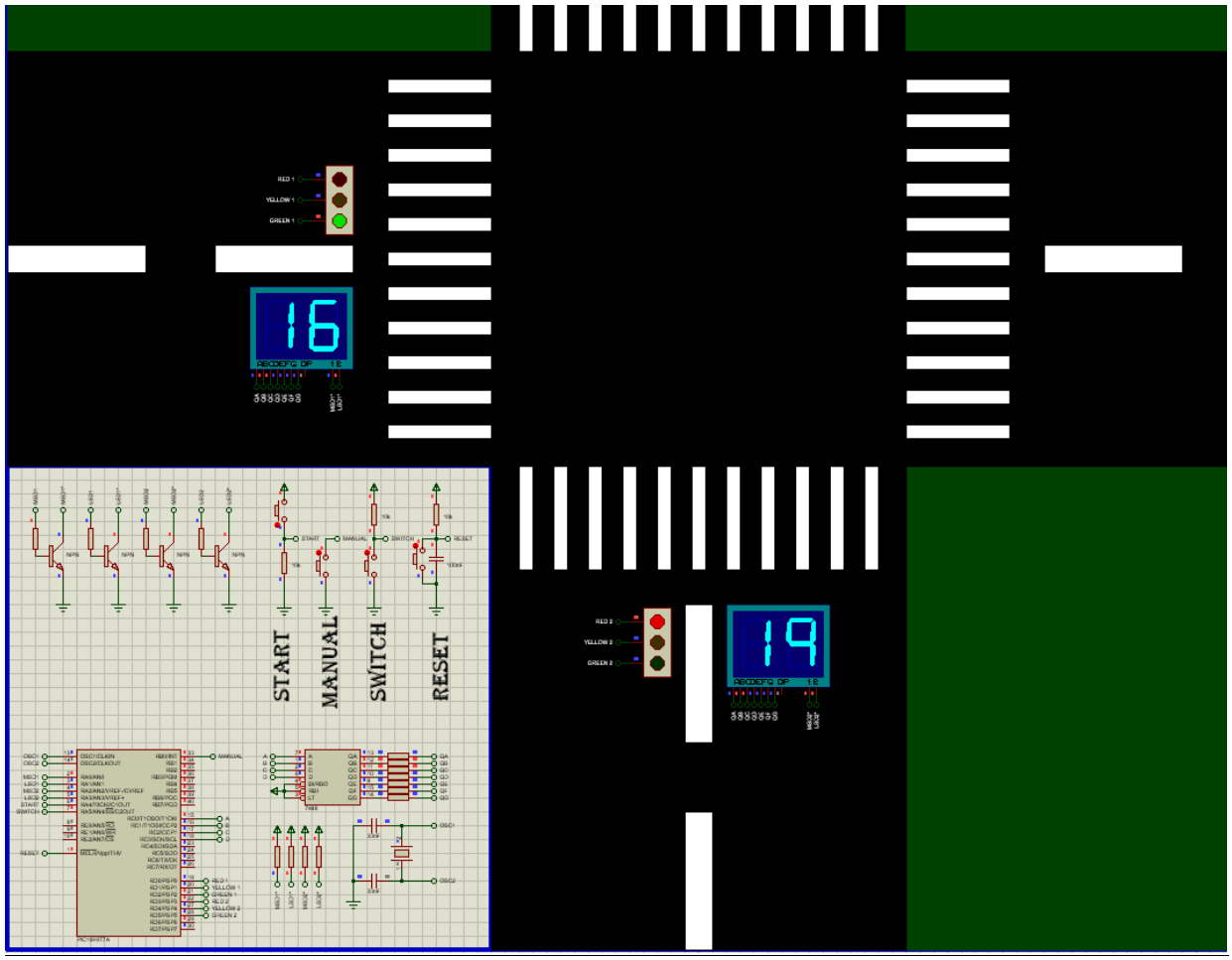
	ATMega328P	PIC16f877A
Memory Size (Flash Memory)	32KB	14KB
Power consumption	Low power consumption	High power consumption
Pins count	28 pins	40 pins

ATMega328P is a better choice than the PIC16f877A in:

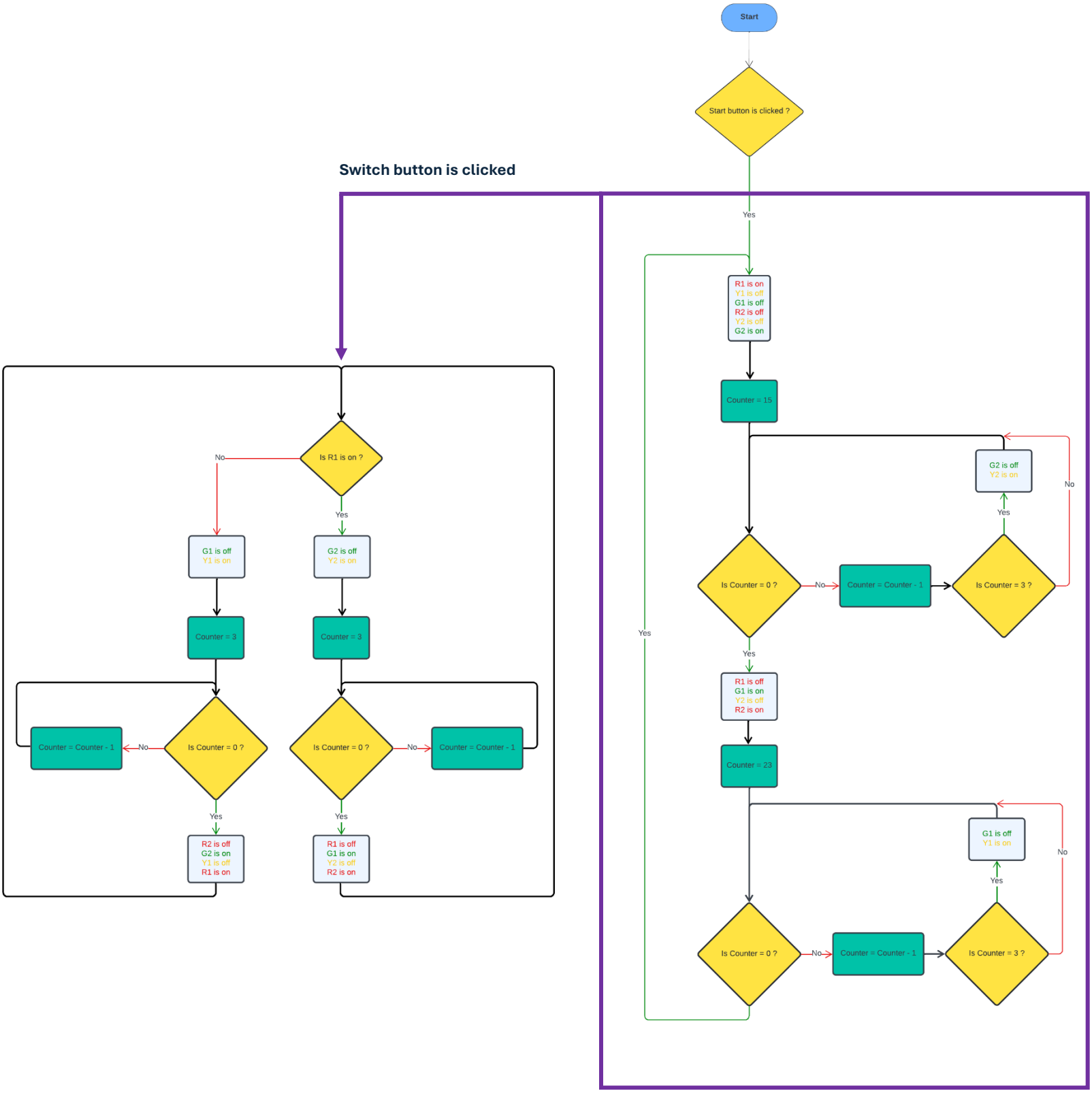
Battery-powered devices due to its large flash memory and low power consumption, the ATMega328P is a better choice for battery-powered devices such as **(remote controls, wireless sensors, and other low-power applications).**

DIY electronics projects, it is the microcontroller that is used in basic Arduino boards such as the **(Arduino Nano, and Arduino UNO, Arduino Pro Mini).**

Traffic Light using PIC16f877A



Flowchart


Start
Start button is clicked ?
Yes
Switch button is clicked
R1 is on
Y1 is off
G1 is off
R2 is off
Y2 is off
G2 is on
Counter = 15
G2 is off
Y2 is on
No
Yes
Is Counter = 0 ?
No
Counter = Counter - 1
Is Counter = 3 ?
Yes
R1 is off
G1 is on
Y2 is off
R2 is on
Counter = 23
G1 is off
Y1 is on
No
Yes
Is Counter = 0 ?
No
Counter = Counter - 1
Is Counter = 3 ?
Yes
Is R1 is on ?
No
Yes
G1 is off
Y1 is on
G2 is off
Y2 is on
Counter = 3
Counter = 3
Counter = Counter - 1
No
Is Counter = 0 ?
Is Counter = 0 ?
No
Counter = Counter - 1
Yes
Yes
R2 is off
G2 is on
Y1 is off
R1 is on
R1 is off
G1 is on
Y2 is off
R2 is on