MPMC PROJECT

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TOPIC:

Interfacing 7 Segment Display to 8051

using Atmel AT89C51ED2

Contents: -

Acknowledgement

A project represents a medium to bridge the gap between theoretical material and practical approach. So, we would like to express our gratitude to our Microprocessor and Microcontroller Prof. Dr Prashant Giri who indulged us in making a mini project on the subject.

We would also like to thank the T.As and Lab assistant Mr. Nikhil for assigning and guiding us in this project.

Circuit Components: -

- AT89C51ED2 Microcontroller
- AT89C51ED2 Programming board
- Programming cable
- 12V DC battery or adaptor
- Common Cathode 7 segment Display
- Resistors – 10KΩ X 2, 330Ω, 1KΩ X 8, 470Ω X 4
- 1KΩ X 8 Resistor Pack
- 33pF Ceramic capacitors x 2
- 11.0592 MHz crystal
- 10μF Electrolytic capacitor
- Connecting wires

Theory and Specifications: -

Atmel AT89C51ED2: -

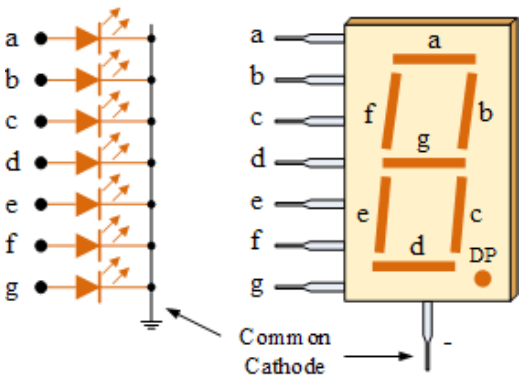
The Atmel AT89C51ED2 is an 80C52 Compatible High-Speed Microcontroller with the following features: -

- Up to 6 8-bit I/O Ports
- 3 16-bit Timer/Counters
- 256 Bytes Scratch Pad RAM
- 9 Interrupt Sources with 4 Priority Levels
- Integrated Power Monitor ISP (In-System Programming)
- 64K Flash on-chip
- 1792 bytes on-chip XRAM
- On-chip 2048 Bytes EEPROM
- Dual Data Pointer
- SPI, 16-bit PCA
- PWM, UART, WDT

7-Segment Display: -

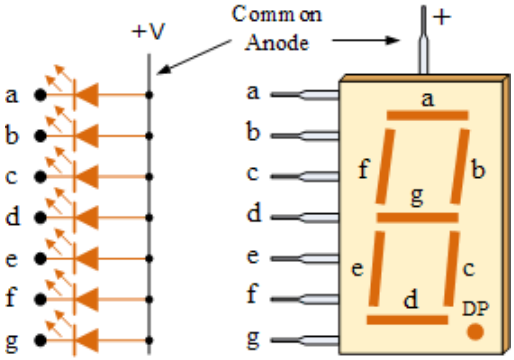
The 7-segment display, also written as “seven segment display”, consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed. An additional 8th LED is sometimes used within the same package thus allowing the indication of a decimal point, (DP) when two or more 7-segment displays are connected together to display numbers greater than ten.

Common Cathode 7-segment Display: -



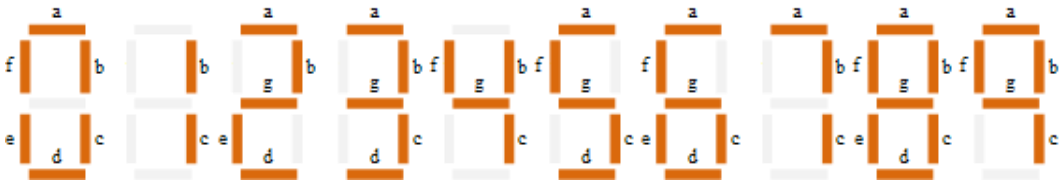
The Common Cathode (CC) – In the common cathode display, all the cathode connections of the LED segments are joined together to logic "0" or ground. The individual segments are illuminated by application of a "HIGH", or logic "1" signal via a current limiting resistor to forward bias the individual Anode terminals (a-g).

Common Anode 7-segment Display: -



The Common Anode (CA) – In the common anode display, all the anode connections of the LED segments are joined together to logic "1". The individual segments are illuminated by applying a ground, logic "0" or "LOW" signal via a suitable current limiting resistor to the Cathode of the particular segment (a-g).

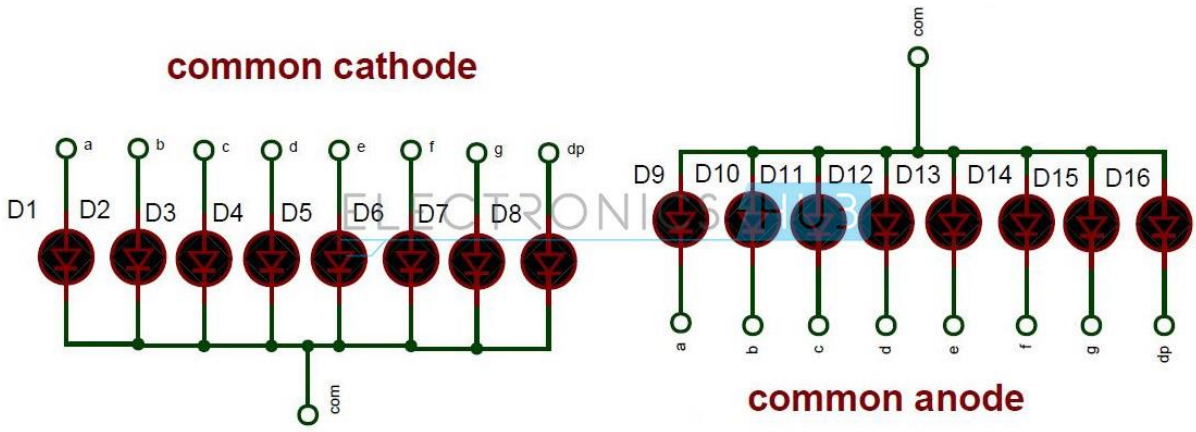
Depending upon the decimal digit to be displayed, the particular set of LEDs is forward biased. For instance, to display the numerical digit 0, we will need to light up six of the LED segments corresponding to a, b, c, d, e and f.



Circuit Principle: -

Seven segment displays internally consist of 8 LEDs. In these LEDs, 7 LEDs are used to indicate the digits 0 to 9 and single LED is used for indicating decimal point. Generally, seven segments are two types, one is common cathode and the other is common anode.

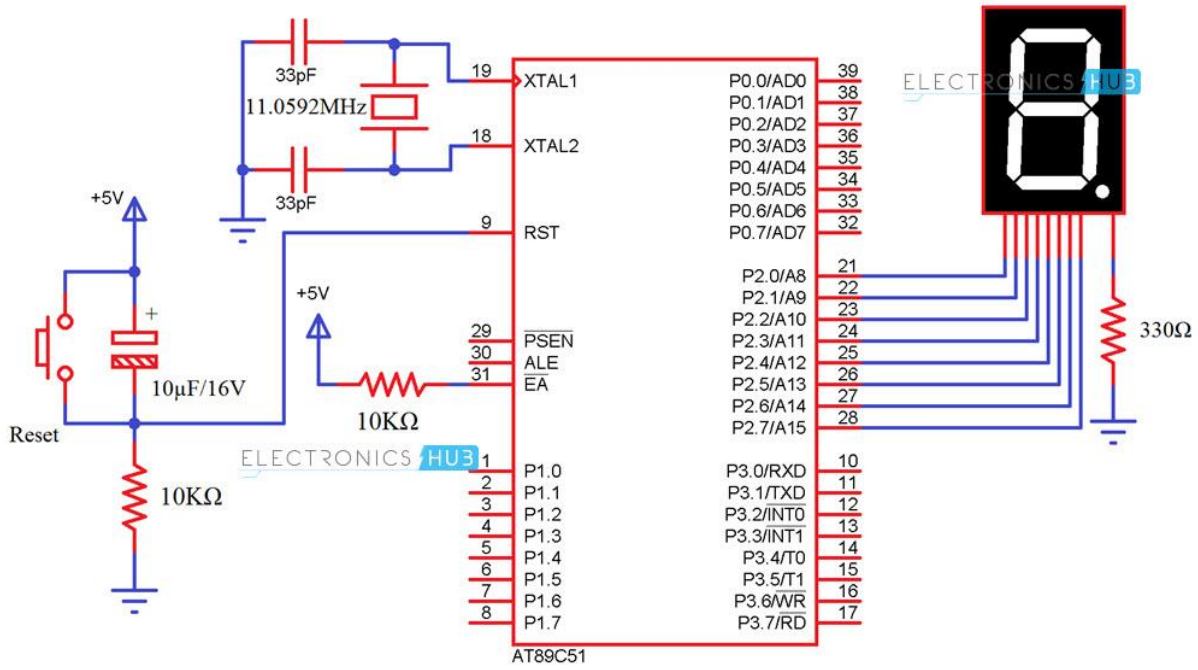
In common cathode, all the cathodes of LEDs are tied together and labelled as com. and the anode are left alone. In common anode, 7-segment display all the anodes are tied together and cathodes are left freely. Below figure shows the internal connections of seven segment Display.



Circuit Diagram: -

Interfacing 7 Segment Display to 8051 (Single Digit – CC)

We are interfacing a Single Digit 7 Segment display with 8051. The 7-Segment Display is of common cathode type.



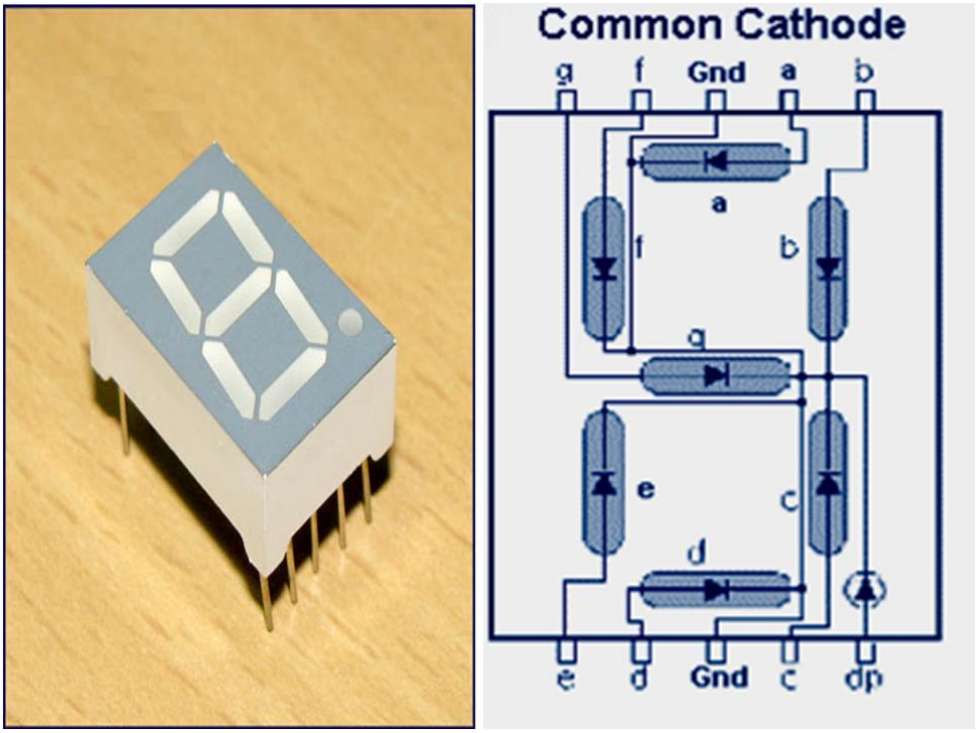
7-Segment Display Features: -

- Available in two modes Common Cathode (CC) and Common Anode (CA)
- Available in many different sizes like 9.14mm,14.20mm,20.40mm,38.10mm,57.0mm and 100mm (Commonly used/available size is 14.20mm)
- Available colours: White, Blue, Red, Yellow and Green (Res is commonly used)
- Low current operation, better, brighter and larger display than conventional LCD displays.
- Current consumption: 30mA / segment
- Peak current: 70mA

Circuit Design: -

Here, common cathode seven segment is used to display the digits. In this circuit, pins a to g of the 7-segment are connected to the PORT 2 of the microcontroller and *com* pin is connected to the ground through the 330-ohm resistor. This resistor is used to drop the voltage. Since we are using common cathode 7-segment we need to send LOGIC 1 to the segments to glow.

Figure shows structure of common cathode seven segments. Here dot is used for indicating the decimal point. Here all the cathodes of LEDs are connected to the GND pin. The operating voltage of this LEDs is 2 to 3V but from controller we will get 5V so to drop the remaining voltage we have to connect a to g pins to the controller through the resistor.



Common cathode 7 segment Display

Digit Drive Pattern: -

To display the digits on 7-segment, we need to glow different logic combinations of segments. For example, if you want to display the digit 3 on seven segment then you need to glow the segments a, b, c, d and g. The below table show you the Hex decimal values what we need to send from PORT2 to Display the digits from 0 to 9.

Digit	Dp	g	f	e	d	c	b	a	Hex value
0	0	0	1	1	1	1	1	1	0x3f
1	0	0	0	0	0	1	1	0	0x06
2	0	1	0	1	1	0	1	1	0x5b
3	0	1	0	0	1	1	1	1	0x4f
4	0	1	1	0	0	1	1	0	0x66
5	0	1	1	0	1	1	0	1	0x6d
6	0	1	1	1	1	1	0	1	0x7d
7	0	0	0	0	0	1	1	1	0x07
8	0	1	1	1	1	1	1	1	0x7f
9	0	1	1	0	0	1	1	1	0x67

NOTE: These values are suitable only for a Common Cathode display. If you want to drive a Common Anode display, then you have to take the complement of each bit and replace the hexadecimal values in the code.

Algorithm: -

- First initialize all the segment hex values of the digits in an array.

```
unsigned char
arr[10]={0x3f,0x06,0x5b,0x4f,0x66,0x6d,0x7d,0x07,
0x7f,0x67};
```

- Now take for loop and assign array values to the PORT2 with some time delay.

```
for (i=0; i<10; i++)
      {
              P2 = arr[i];
              delay_ms(500);
      }
```

Code: -

```
#include<reg51.h>
void delay(int k)                    //delay function
{
int i,j;
for(i=0;i<k;i++)                  //k millisecond delay
  for(j=0;j<1275;j++);
}
void main()
{
    unsigned char i;
```

```
    unsigned char
    arr[10]={0x3f,0x06,0x5b,0x4f,0x66,0x6d,0x7d,0x07,
    0x7f,0x67};
    P2=0x00;
    while(1)
    {
        for(i=0;i<10;i++)
        {
            P2=arr[i];
            delay(1000);          //1 second delay
        }
    }
}
```

Procedure: -

- Open Keil uVision 3.
- Write the program and build the target.
- Burn the program to the microcontroller.
- Give the connections as per the circuit diagram.
- Make sure that a to g pins of 7-segment are connected to the P2.0 to P2.6 respectively in the circuit.
- Switch on the supply, you can observe that digits 0 to 9 will display continuously with some delay in the circuit.
- Switch off the supply.

Applications: -

- Seven segments are widely used in digital clocks to display the time.
- These are used in electronic meters for displaying the numerical information.
- Used in Instrument panels
- Used in digital readout displays.
- Used in combination with four segments to display measurement/sensor value with four characters.

Limitations: -

- The complexity is increased to display large information.
- It is not possible to display the symbols on 7-segment.

Conclusion: -

The interfacing of 7-Segment Display to Atmel AT89C51ED2 Microcontroller was implemented and verified successfully using Keil uVision and Atmel FLIP.

References: -

- https://www.electronicshub.org/interfacing-7-segment-display-8051/
- https://components101.com/7-segment-display-pinout-working-datasheet
- http://www.keil.com/dd/chip/3599.htm?_ga=2.16241270.1976708843.1574146222-1915784595.1574146222