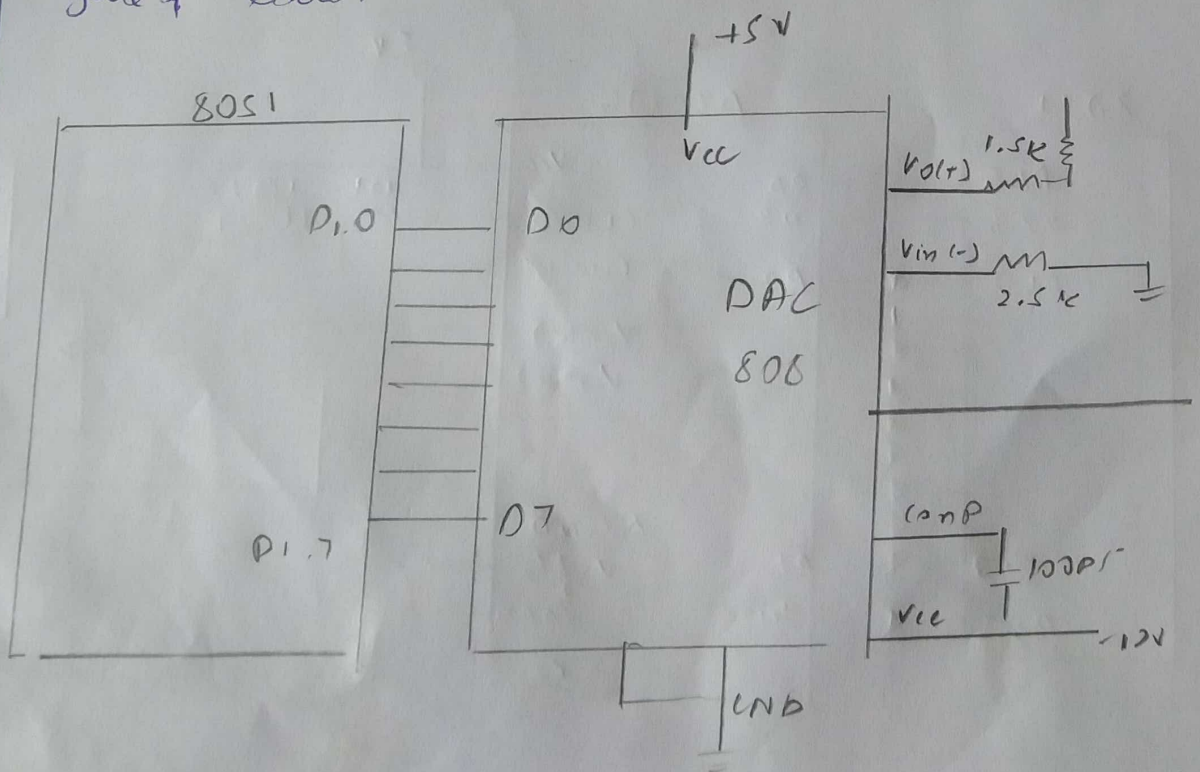
7) a) Interface D/A & A/D converter with 8051 & explain in detail.

Digital to Analog (DAC) converter:

The digital inputs are converted to current Iout and by connecting resistor the Iout we can convert the result to voltage. The total current Iout is a function of the binary numbers at the D0 - D7 inputs of the DAC0808 and the reference current Iref. and is as follows

$$I_{out} = I_{ref}\left(\frac{D7}{2} - \frac{D6}{4} - \frac{D5}{8} + \frac{D4}{16} + \frac{D3}{32} - \frac{D2}{64} - \frac{D1}{128} + \frac{D0}{256}\right)$$

Usually reference current is 2mA. Ideally we connect the output pin to a resistor, convert this current to voltage, and monitor the output on the scope. But this can cause inaccuracy, hence an opamp is used to convert the output current to voltage. The 8051 connection to DAC 0801 is as shown in the figure & below.

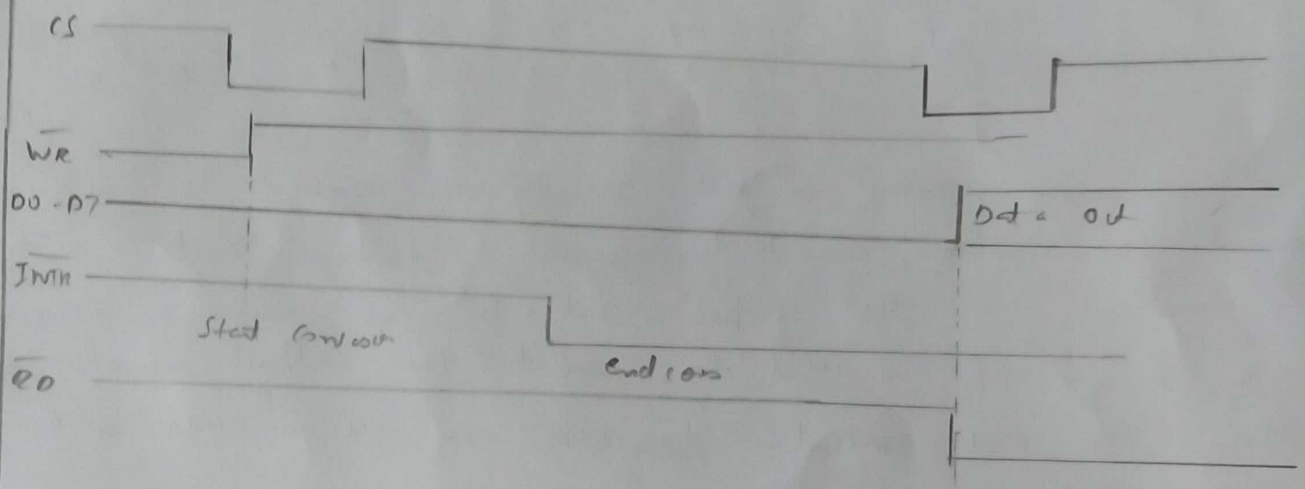


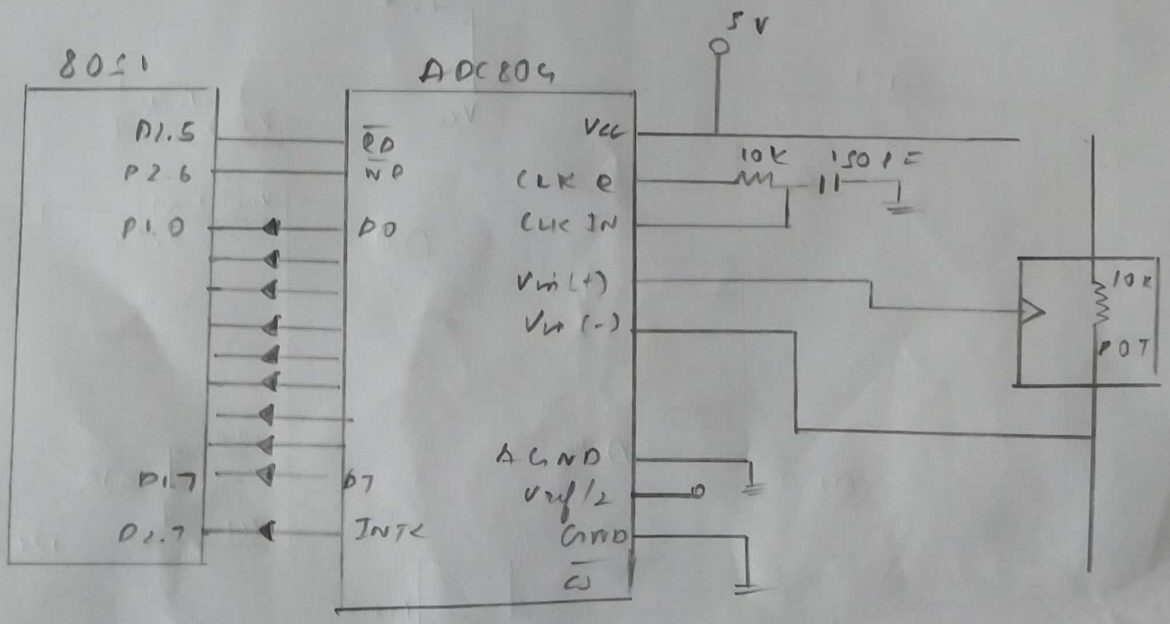
Analog to digital converter

The following steps must be followed to do data conversion by the ADC 804 chip

1. Make CS = 0 and send a 1 to 0 pulse to the WR to start conversion
2. Monitor the INTR pin, if high keep polling, but if low, conversion is complete, go to next step.
3. Make CS = 0 and send 0 - to 1 pulse to the RD to get the data out

Figure shows the read and write timings for ADC-804.





Stepper Motor Interfacing:

Stepper motor has a magnet rotor called as shaft which is surrounded by stator. The stator has a magnet wired to the electrical coil are connected commonly either to ground or +5V. The other end is provided with a fixed sequence such that the motor rotates in a particular direction.

Step angle:

Step angle is defined as the minimum degree of rotation of a single step.

No of steps per revolution = 360° / step angle

Steps per second = (rpm × steps per revolution) / 60

Example step angle = 1°

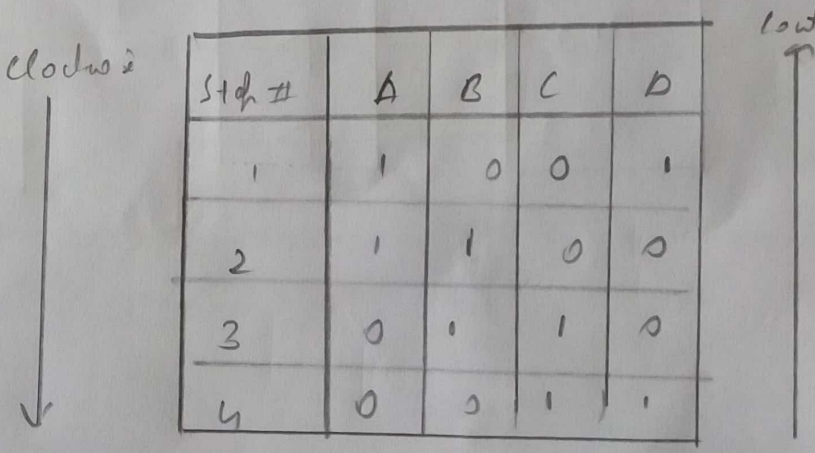
No of steps per revolution = 180

Switching Sequence of Motor:

As discussed earlier the coils need to be energized in the motor. This can be done by sending a step sequence to one end of the coil while the other end is commonly connected. The step sequence set can make either one phase ON or two phase ON. Full step sequence or it can be a combination of one and two phase ON for half step sequence. Both are tabulated below

Full step

Two phase ON



Step #	A	B	C	D
1	1	0	0	1
2	1	1	0	0
3	0	1	1	0
4	0	0	1	1

One phase ON

Clockwise

Step #	A	B	C	D
1	1	0	0	0
2	0	1	0	0
3	0	0	1	0
4	0	0	0	1

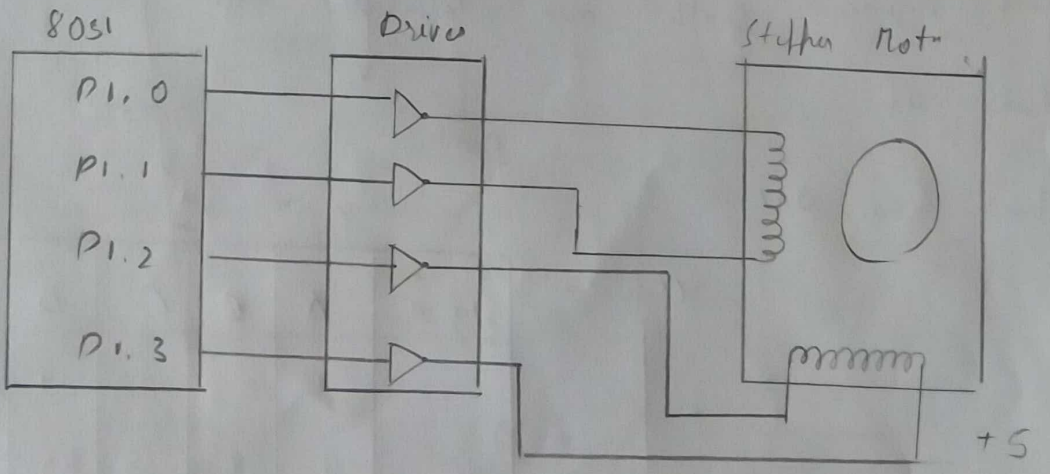
Anti - Clockwise

Half Step (8 - sequence).

The sequence is tabulated below

Step #	A	B	C	D
1	1	0	0	1
2	1	0	0	0
3	1	1	0	0
4	0	1	0	0
5	0	1	1	0
6	0	0	1	0
7	0	0	1	1
8	0	0	0	1

8051 connection to stepper motor



Explain neatly how you can interface 8051 LCD display? ③

LCD's are widely used and preferred over LEDs (7 seg a multi segment LED's) due to the following reasons:

i) the declining price of LCDs

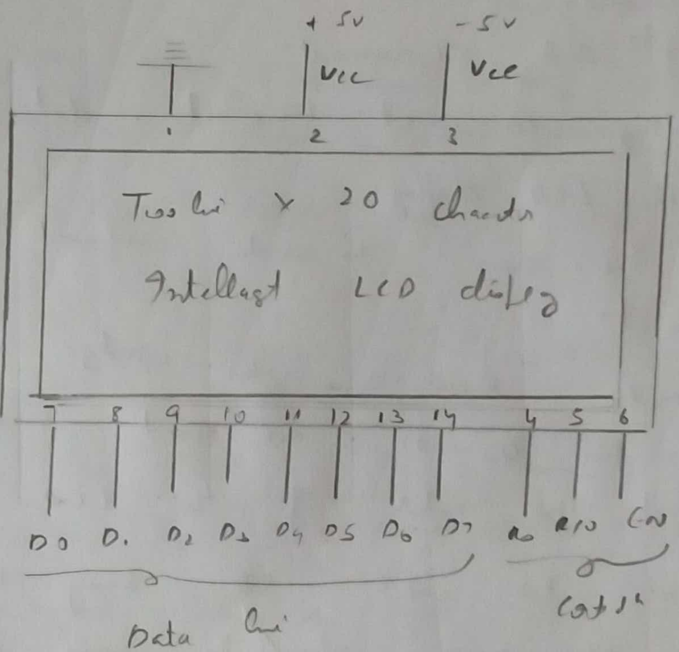
ii) the ability to display numbers, characters and graphics

iii) Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD.

In contrast, the LED must be refreshed by the CPU to keep displaying the data.

iv) ease of programming for characters and graphics.

It's examining an intelligent LCD display of two lines, 20 characters per line, that is interfaced to the 8051

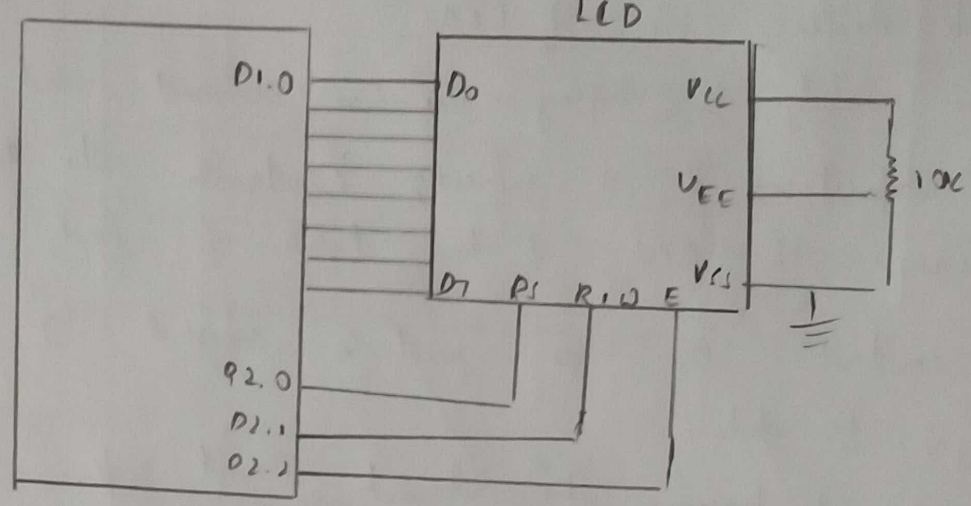


-> The display contains two internal byte wide registers, one for commands (RS=0) & the second for characters to be displayed

-> It also contains a user-programmed RAM (the character RAM) that can be programmed to generate any desired character that can be formed using a dot matrix.

-> Port 1 is used to furnish the command or data byte & ports permit any alert & write lines.

→ The display takes varying amounts of time to accomplish the fu...
→ Usually LCD bit D7 is monitored for a logic high to ensure the display is not over written



LCD Connection to 8051

→ If RS = 0 the instruction command such as clear code reg is selected allows the user to send command.
→ Such as clear display, cursor at home etc. data is treated as a command to the LCD display.
→ R/W i/p allows the user to write information to the LCD or read information from it.
→ R/W = 1 when reading, R/W = 0 when writing
→ The 8 bit data pins D0 - D7 are used to send it to the LCD or read the contents of the LCD int reg
→ we also use RS = 0 to check the busy flag bit to see if the LCD is ready to receive it. The busy flag is D7 and can be read when R/W = 1 and RS = 0 as follows if R/W = 1 RS = 0 when D7 = 1 the LCD is busy ... & care of internal operation will not accept new d.

Interface External RAM & ROM to 8051 microcontroller and explain

Interfacing external ROM with 8051:

→ In 8051 P0 & P2 provide 16 bit address to access the external memory.

→ P0 is multiplexed address/data bus.

→ By using ALE pin

ALE = 0 → data path (access data from P0)

ALE = 1 → address path (access data address from P0)

→ O/P signal of 8051 must be connected to ($\overline{PSEN}$) the OE pin of ROM (storing the program code).

→ $\overline{EA}$ pin (Active low) : 1 → Pgm is on chip ROM

0 → Pgm to be access from external program memory

→ $\overline{PSEN}$: 0 → can access external memory

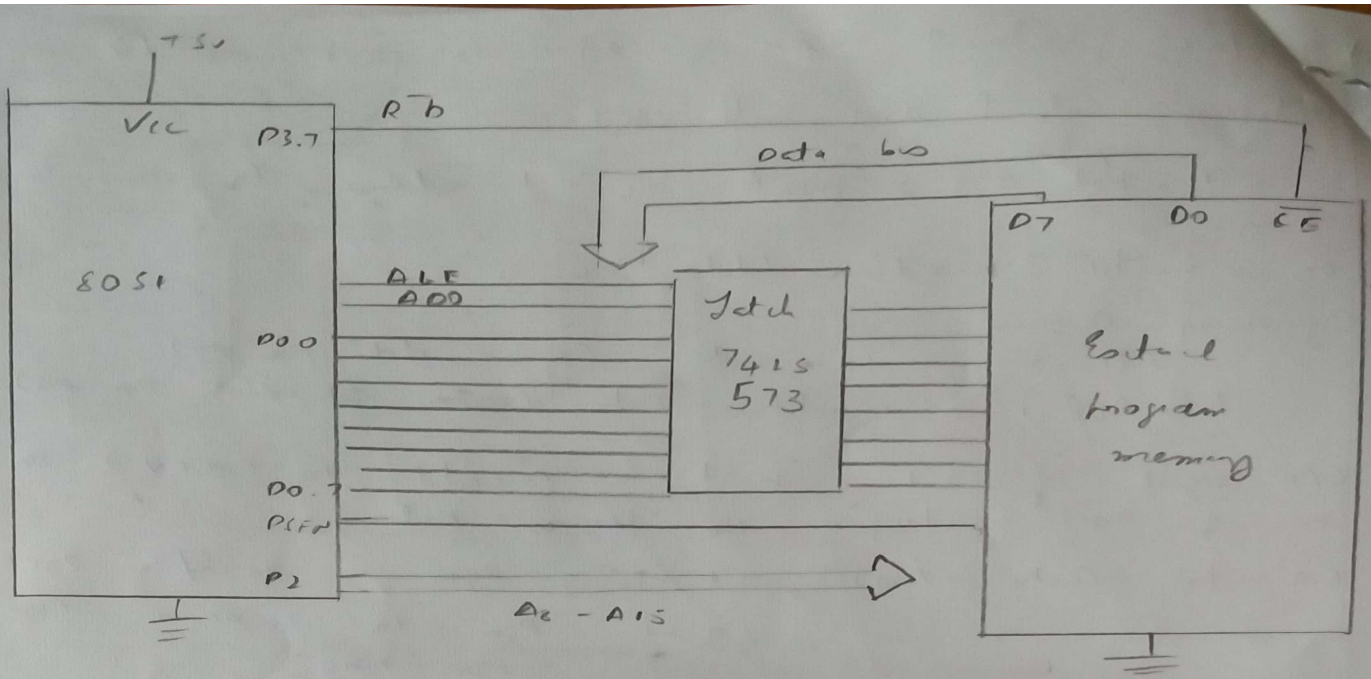
1 → cannot access external memory

→ Latch is a 8 bit latch used for address & data multiplexing

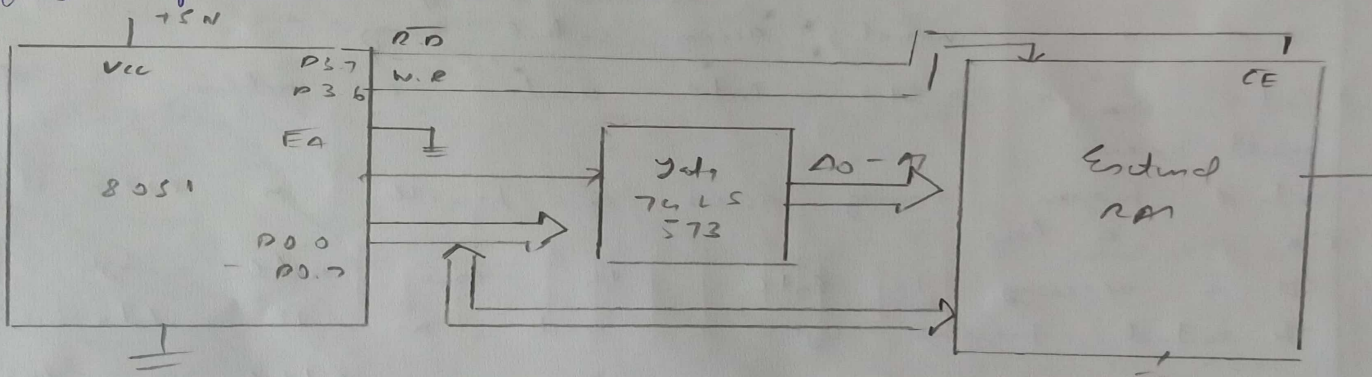
→ External program memory access is possible in 8051, if the $\overline{EA}$ pin is low

→ It is necessary to latch the low address byte when the external program byte is read on the data bus.

→ The low order address byte is latched when the ALE pulse goes low.



Interfaces of external RAM to 8051 :-



→ External data memory upto 64 KB can be accessed using a 16-bit register (DPTR)

→ If the access is to data memory, then the signals RD & WR are generated by 8051

→ During read cycle, RD signal low & a data byte from the addressed memory location is loaded into the data bus

→ WR signal is generated to write the byte into the addressed memory.