

Part IV-8051 Microprocessor Interfacing

10. Stepper Motor Interfacing with 8051.

10.1 Problem Statement:

Write an ALP to trigger a stepper motor with +5V, at an angle of 15 degree in each step in both clockwise and anticlockwise with same speed and different speeds.

10.2 Hardware Requirement:

The 8051 Microcontroller kit, Stepper motor interface add on card, interface cable, Power Supply.

10.3 Program Logic:

A motor in which the rotor is able to assume only discrete stationary angular position is a stepper motor. The rotor motion occurs in a stepwise manner from one equilibrium position to the next. They are widely used in open and closed looped systems in a variety of applications. It is either of reluctance type or permanent magnet type. The four poles structure is continuous with the stator frame and the magnetic field passes through the cylindrical stator annular ring. The stator poles and three pairs of rotor poles, there exists 12 possible positions in which a south pole of the rotor can lock with the north pole of the stator. From this it can be noted that the step size is $360(\text{ in degrees})/ N_s \times N_r$

where N_s = number of stator poles

N_r = number of pair of rotor poles.

There are three different stepping schemes for a stepper motor.

1. Wave scheme
2. 2- phase scheme
3. half stepping and mixed scheme

10.3.1 Wave scheme

The stepper motor windings A1,A2,B1,B2 can be cyclically excited with a DC current to run the motor in the clockwise direction. Consider the four rotor positions of the motor along with the stator excitations. The switching scheme for the wave mode excitation is given as follows.

Clockwise					Anti-Clockwise				
Step	A1	A2	B1	B2	Step	A1	A2	B1	B2
1	1	0	0	0	1	1	0	0	0
2	0	0	0	1	2	0	0	1	0
3	0	1	0	0	3	0	1	0	0
4	0	0	1	0	4	0	0	0	1

10.3.2 2- Phase scheme:

In this scheme the two adjacent stator windings are energized. There are two magnetic fields achieved in quadrature and none of the rotor pole faces can be in a direct alignment with the stator poles.

The switching scheme for the 2- phase mode excitation is given as follows.

Clockwise					Anti -Clockwise				
Step	A1	A2	B1	B2	Step	A1	A2	B1	B2
1	1	0	0	1	1	1	0	1	0
2	0	1	0	1	2	0	1	1	0
3	0	1	1	0	3	0	1	0	1
4	1	0	1	0	4	1	0	0	1

10.3.3 Half stepping scheme

The previously discussed two schemes have a step size of 30 degrees for the stepper motor under consideration. However there is a offset of 15 degrees between these two schemes. By interleaving these two schemes , the step size can be reduced to 15 degrees there by improving the accuracy of the motor. This is called half stepping scheme.

The switching sequence is as follows.

1. A1 on
2. A1 and B1 on
3. B1 on
4. B1 and A2 on
5. A2 on
6. A2 and B2 on
7. B2 on
8. B2 and A1 on
9. A1 on etc.

10.4 Program

Stepper Motor With Varying Angles (Clockwise And Anticlockwise)

MEMORY ADDRESS	LABEL	MNEMONICS	OP CODE	COMMENTS
	L4	MOV DPTR,#4500		
		MOV R0,#04		
	L3	MOVX A,@DPTR		
		PUSH DPH		
		PUSH DPL		
		MOV DPTR,#FFC0		
		MOVX @DPTR,A		
		MOV R4,#70		
	L2	MOV R5,#70		
	L1	DJNZ R5,L1		
		DJNZ R4, L2		
		POP DPL		
		POP DPH		
		INC DPTR		
		DJNZ R0,L3		
		SJMP L4		

10.5 Pre-Lab Questions:

1. State applications of stepper motor in control systems
2. Draw the 4 possible rotor positions and the corresponding stator excitations in a stepper motor
3. What is the specific property of the stepper motor which makes it compatible to interface with the processor?
4. Can a single phase motor or a DC motor be interfaced with a 8086 processor?
5. What is the operating voltage of a stepper motor?
6. What are the different types of stepper motor?
7. State any two applications of stepper motor interfaced with 8086.

10.6 Post Lab Questions:

1. Write a program to run the stepper motor for any number of steps and to stop it.
2. What is meant by step angle?
3. What do you mean by the instruction out C0 in the program?
4. What is the value of the delay element used in the program?
5. Write a program to interface the stepper motor with 8051 and make it run in clockwise and anti clock wise direction.
6. Write an ALP to control conveyer belt using stepper motor and 8051 controller. Belt moves continuously at the rate of 1 step/sec, but stops for 5secs, when external interrupt occurs ant then continues to move.
7. Design a stepper motor controller and write an ALP to rotate shaft of a 4 phase stepper motor.,
 - (i) in clockwise 5 rotations.
 - (ii) in anticlockwise 5 rotations.