Experiment No. 5

Title: Study and Control of stepper motor.

Aim: To interface stepper motor to 8051.

**Apparatus:** Stepper motor, 8051 trainer kit.

Theory:
Stepper motors:
A stepper motor is known by its important property to convert a train of pulses into a precisely defined Increment in the shaft position. A stepper motor is a widely used a device that translates electrical pulses into mechanical movement. In applications such as disk drivers, dot matrix printers, and robotics, the stepper motor is used for position control. every stepper motor has a permanent magnet rotor (also called as shaft)surrounded by a stator the most common stator motors have four stator windings that are paired with a center-tapped common as shown in the figure. This type of stator motor is commonly referred to as four phase stepper motor .the center tap allows a change of current direction in each of two coils ,when a winding is grounded, thereby resulting in polarity change of the stator. Notice that while a conventional motor shaft runs freely, the stepper motor shaft moves in a fixed repeatable increment which allows one to move it to a precise position.
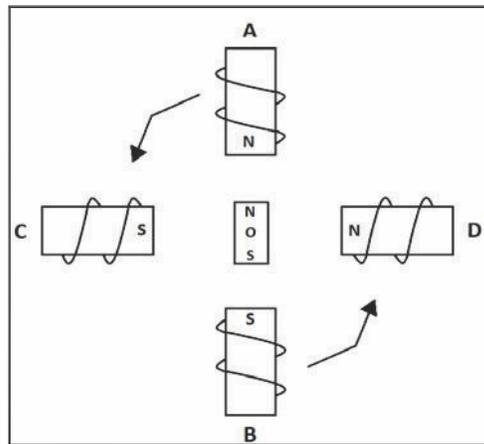
This repeatable fixed movement is possible as a result of basic magnetic theory where poles of same polarity repel and opposite attract. The direction of rotation is indicated by the stator poles. The stator poles are determined by the current sent through the wire coils. As the direction of current is changed, the polarity is also changed causing the

reverse motion of the rotor. The stepper motor discussed here has a total of six leads: four leads representing the four stator windings and two commons for the center tapped leads. As the sequence of power is applied to each stator winding, the rotor will rotate. There are several widely used sequences where each has a different degree of precision.
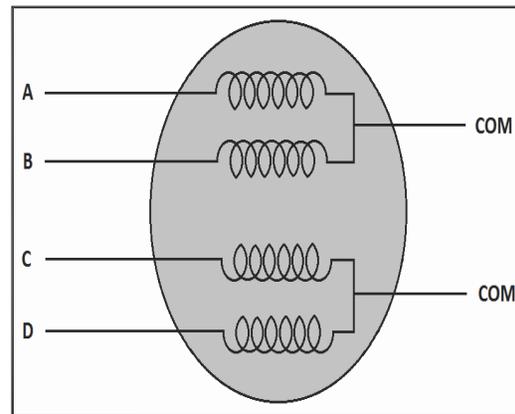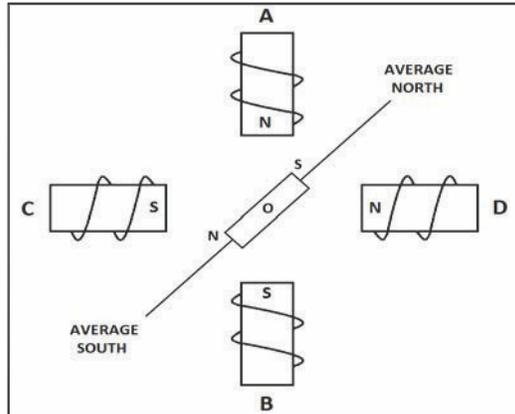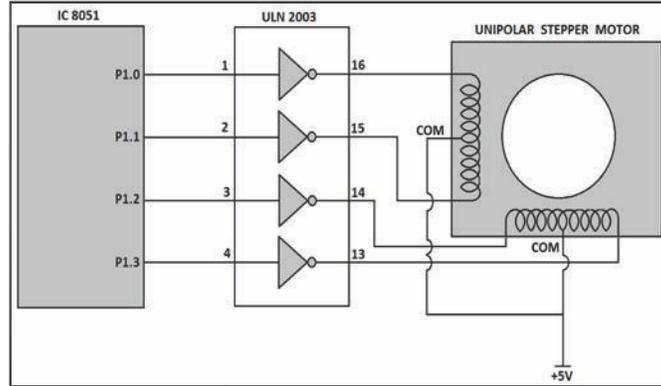

STATOR WINDINGS

The stepper motors are divided into three categories:
1. Variable reluctance stepper motor
2. Permanent magnet stepper motor
3. Hybrid stepper motor

The clockwise and anticlockwise movement of stepper motor can be governed by writing 8051 Assembly language program. The two types of relations can be performed by clubbing two individual programs for each rotation by using a single switch which can be connected to Vcc (high logic) or to ground (low logic).The sequence followed by the stepper motor to rotate in clockwise direction is 05H, 09H, 0AH, 06H.and to rotate the stepper motor in anticlockwise direction we use exactly opposite sequence which is 06H, 0AH, 09H, 05H.

8051 connection to stepper motor:

1. Use an ohmmeter to measure the resistance of the leads. This should identify which
   COM leads are connected to which winding leads.
2. The common wire is connected to the positive side of the motor's power supply.
3. The 4 leads of the stator winding are controlled by four bits of the 8051 port (P1.0- P1.3). However, since 8051 lacks sufficient current to drive the stepper motor windings, we must use a driver such that the ULN2003 to energize the stator. Instead of the ULN2003, we could have used transistors as drivers.
4. However, notice that if transistors are used as drivers, we must also use diodes to take care of inductive current generated when the coil is turned off. One reason that the ULN2003 is preferable to the use of transistors as drivers is that the ULN2003 has an internal diode to take care of back EMF.

Applications:
The stepper motors are widely used in X-Y plotters, floppy disks, machine tools, process control system, robotics, printers, tape drivers and variety of other industrial applications.

Programs:

1. Program to rotate the stepper motor in anti-clockwise direction:

Label	Mnemonic	Operand	mment
	ORG	000H	Initialize program counter to 00H
	LJMP	MAIN	Jump to main program
	ORG	0030H	Load program counter with 30H
MAIN:	MOV	P1, #05H	Out value to P1
	ACALL	DELAY	Hold value for some time.
	MOV	P1, #06H	Out value to P1
	ACALL	DELAY	Hold value for some time.
	MOV	P1, #0AH	Out value to P1

	ACALL	DELAY	Hold value for some time.
	MOV	P1, #09H	Out value to P1
	ACALL	DELAY	Hold value for some time.
	SJMP	MAIN	Continue rotating the motor unconditionally
DELAY:	MOV	R2, #0AH	Move 0AH as count value in outer counter R2
H1:	MOV	R3, #0FFH	Move FFH as count value in inner counter R3
H:	DJNZ	R3, H	Decrement inner counter and jump to H label till it becomes 0
	DJNZ	R2, H1	Decrement outer counter and jump to H1 label until it becomes 0
	RET		Return to next instruction
	END		End

2. **Program to rotate the stepper motor in clockwise direction:**

LABEL	MNEMONIC	OPERANDS	COMMENTS
	ORG	000H	Initialize program counter to 00H
	LJMP	MAIN	Jump to main program
	ORG	0030H	Load program counter with 30 H
MAIN:	MOV	P1, #09H	Load value in P1
	ACALL	DELAY	Hold value for some time.
	MOV	P1, #0AH	Load value in P1
	ACALL	DELAY	Hold value for some time.
	MOV	P1, #06H	Load value in P1
	ACALL	DELAY	Hold value for some time.
	MOV	P1, #05H	Load value in P1
	ACALL	DELAY	Hold value for some time.
	SJMP	MAIN	Continue rotating motor continuously
DELAY:	MOV	R2, #0FFH	Take R2 as outer counter and load FH as count value
H1:	MOV	R3, #0FFH	Take R3 as inner counter and load FFH as count value
H:	DJNZ	R3, H	Decrement R3 and jump to H label until it becomes 0
	DJNZ	R2, H1	Decrement R2 and jump to H1 label until it becomes 0
	RET		Return to the next instruction
	END		end