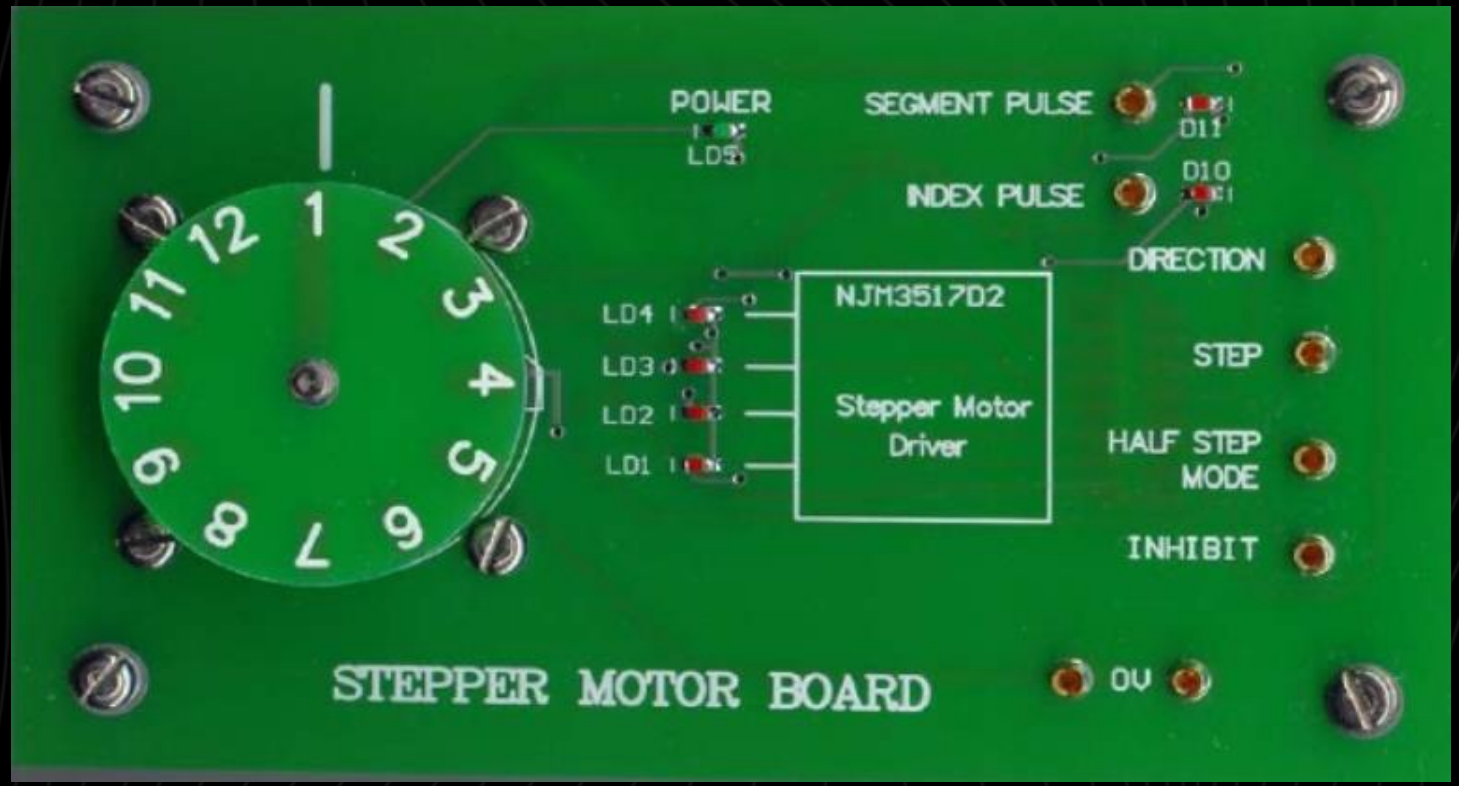
Stepper Motor

AKSHAY GIRIDHARAN	51
PAYAL THORAT	59
SAMUEL ROBERT	26
SNEHA SABLE	27
DHANRAJ SHETTY	46

Introduction

- A **stepper motor** is a brushless, synchronous electric motor that converts digital pulses into mechanical shaft rotation.
- Every revolution of the stepper motor is divided into a discrete number of steps, in many cases 200 steps, and the motor must be sent a separate pulse for each step.
- The stepper motor can only take one step at a time and each step is the same size. Since each pulse causes the motor to rotate a precise angle, typically 1.8°, the motor's position can be controlled without any feedback mechanism step.
- As the digital pulses increase in frequency, the step movement changes into continuous rotation, with the speed of rotation directly proportional to the frequency of the pulses.

STEPPER MOTOR BOARD



WORKING OF STEPPER MOTOR

- A stepper motor has a rotating part called a rotor and a static part termed Stator. The Stator and rotor have magnetic poles and by energizing the Stator poles, the rotor moves to align itself along with the stator.
- When the phase winding of the stepper motor is provided with a current, corresponding magnetic flux will be developed in the stator in the direction perpendicular to the direction of the current flow.
- When one electromagnet is energized with the help of an external driver circuit or a microcontroller, the rotor shaft turns in such a way that it aligns itself with the stator in a position that minimizes the flux opposition.
- And when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one. From there the process is repeated.

WORKING OF STEPPER MOTOR

- **Wave Drive**

In wave Drive stepping mode only one Phase is energized at a time.

- **Full Step Drive**

In this technique, two stators are activated at a time instead of one in a very less time period. This technique results in high torque & allows the motor to drive the high load.

- **Half Step Drive**

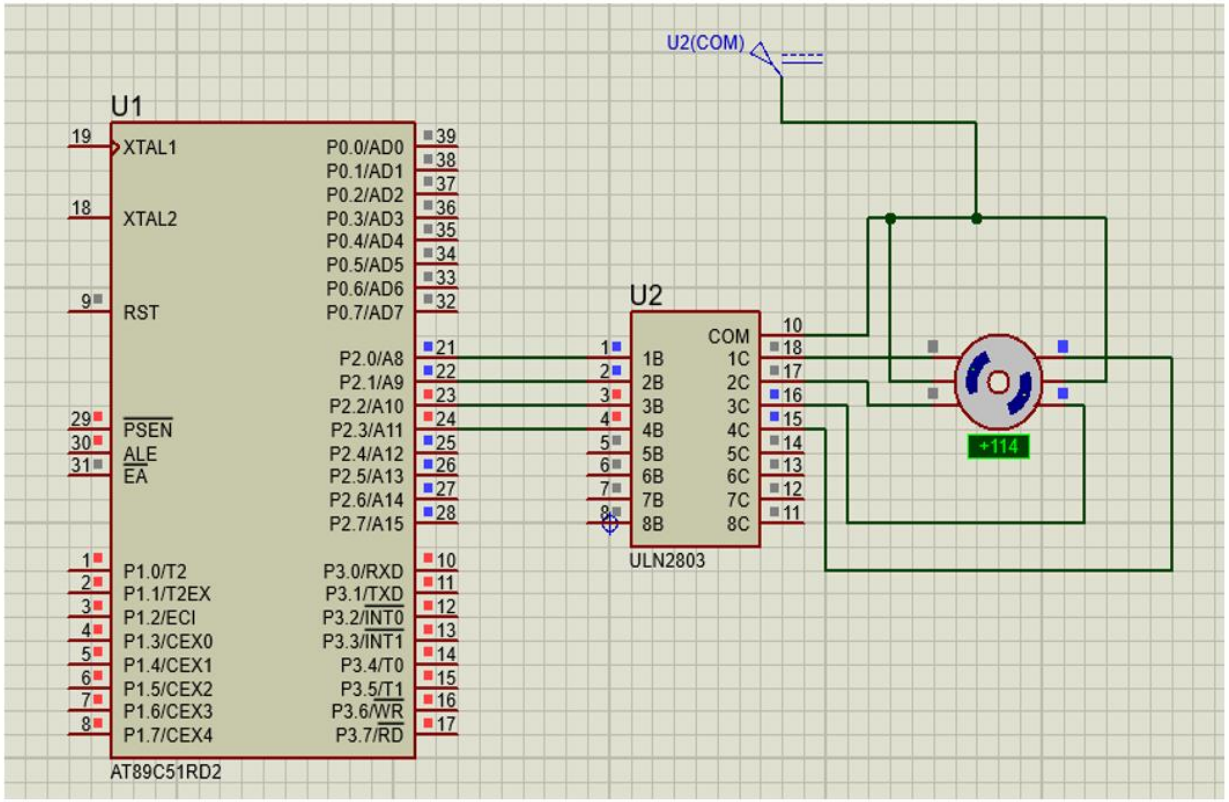
This technique is fairly related to the Full step drive because the two stators will be arranged next to each other so that it will be activated first whereas the third one will be activated after that. This kind of cycle for switching two stators first &after that third stator will drive the motor. This technique will result in improved resolution of the stepper motor while decreasing the torque.

Important terminology related to a stepper motor

1. **Revolutions Per Minute (RPM):** This term is often used when the number of rotations is to be found per minute. It determines the frequency with which the motor is rotating.
2. **Step Angle:** Since a stepper motor rotates one step at a time, the angle it sweeps in one step is called the Step Angle. For a rotor having 200 steps/teeth, it is equal to 1.8 degrees and for a motor having 4 steps, it is equal to 90 degrees.
3. **Steps per revolution:** This parameter decides the number of steps required to complete one revolution and is determined by 360 / (Step Angle).
4. **Steps per second:** As suggested by the name it determines the steps covered in one second and is given by

Steps per second = RPM x steps per revolution / 60

SCHEMATIC CIRCUIT DIAGRAM



Components Required

Hardware Requirements

- ✓ 89c51 microcontroller
- ✓ Stepper motor (unipolar)
- ✓ Motor driver (ULN2803)
- ✓ Crystal (16MHz
- ✓ Capacitors (22pF)
- ✓ Push Button
- ✓ Jumper wires
- ✓ PCB

Software Requirements

- ✓ Proteus 8.6
- ✓ Keil µVision IDE

HEX CODE

4- Step sequence binary pattern				HEX code	Comments
A	B	C	D		
1	0	0	1	09	Sequence for Clock wise rotation
1	1	0	0	0C	
0	1	1	0	06	
0	0	1	1	03	
0	0	1	1	03	Sequence for anti-clockwise rotation
0	1	1	0	06	
1	1	0	0	0C	
1	0	0	1	09	

PROGRAM CODE

```
UP:MOV P2, #09H
ACALL DELAY
MOV P2, #0CH
ACALL DELAY
MOV P2, #06H
ACALL DELAY
MOV P2, #03H
ACALL DELAY
ORG 0000H
SJMP UP

DELAY:MOV R4, #18
H1: MOV R3, #255
H2: DJNZ R3, H2
DJNZ R4, H1
RET
END
```

APPLICATIONS

- As the stepper motor are digitally controlled using an input pulse, they are suitable for use with computer controlled systems.
- Used in Dot Matrix Printer.
- They are used in numeric control of machine tools.
- Used in tape drives, floppy disc drives, printers, and electric watches.
- Metal cutting & Metal forming machines.
- The stepper motor also use in X-Y plotter and robotics.
- It has wide application in textile industries and integrated circuit fabrication.
- These motors also find a variety of commercial, medical and military applications and also used in the production of science fiction movies

CONCLUSION

- That project can be used perfectly in many areas.
- The device is easy to implement in hardware and software means.
- The circuit is cost-effective consume less power and take minimum time.