# VIDEO#24: Electronic Basics #24: Stepper Motors and how to use them

Stepper Motors and Their Working Principles

Introduction

Stepper motors are widely used in applications requiring precise positioning, such as 3D printers. Although they generate characteristic noise, they offer advantages over brushed DC motors. Hybrid synchronous stepper motors, the most common type, consist of a rotor with permanent magnets and a stator with teeth that become magnetized when powered. The rotor's motion is controlled through the activation of coil pairs, leading to stepwise movement. Since each tooth moves in four steps and the rotor has 50 teeth, a full rotation consists of 200 steps, resulting in a step angle of 1.8°.
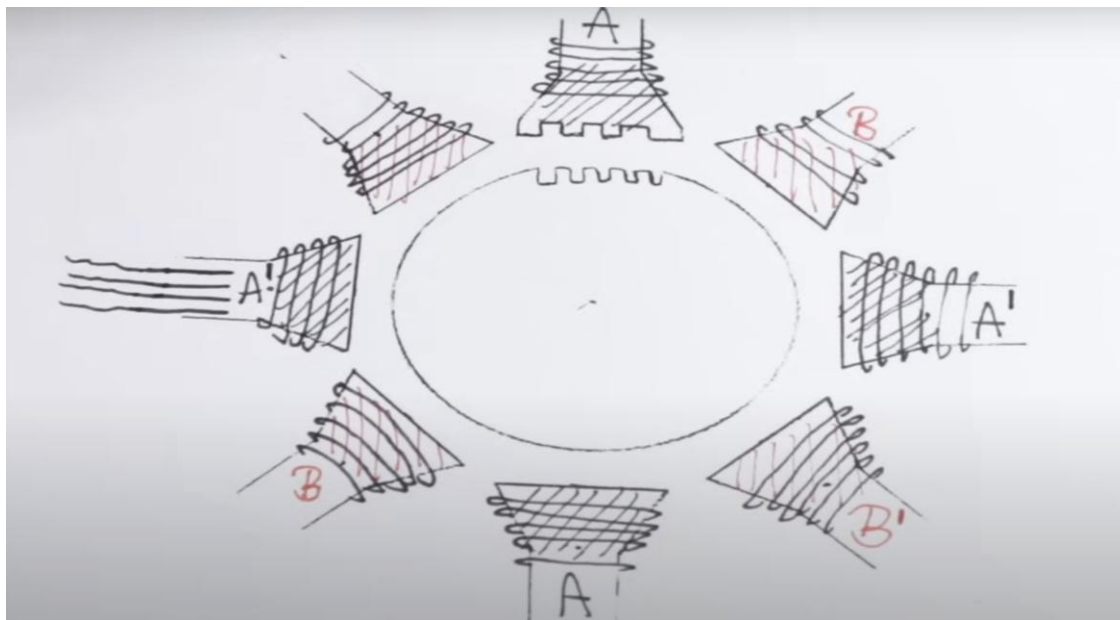
Motor Driver and H-Bridge Functionality

Manually controlling the coils is impractical, requiring a motor driver. The driver circuit uses H-bridges formed by MOSFETs, enabling bidirectional current flow through the coils. By applying control logic, the stepper motor achieves accurate movement, making it suitable for precision applications.

Stepper Motor Driving Modes

Various driving modes exist, including wave driving (one coil active at a time), full-step driving (two coils active for increased torque), and half-step driving (combining both for higher resolution). Microstepping further divides steps into finer increments like 1/4, 1/8, and 1/16 steps, improving motion smoothness and reducing noise.
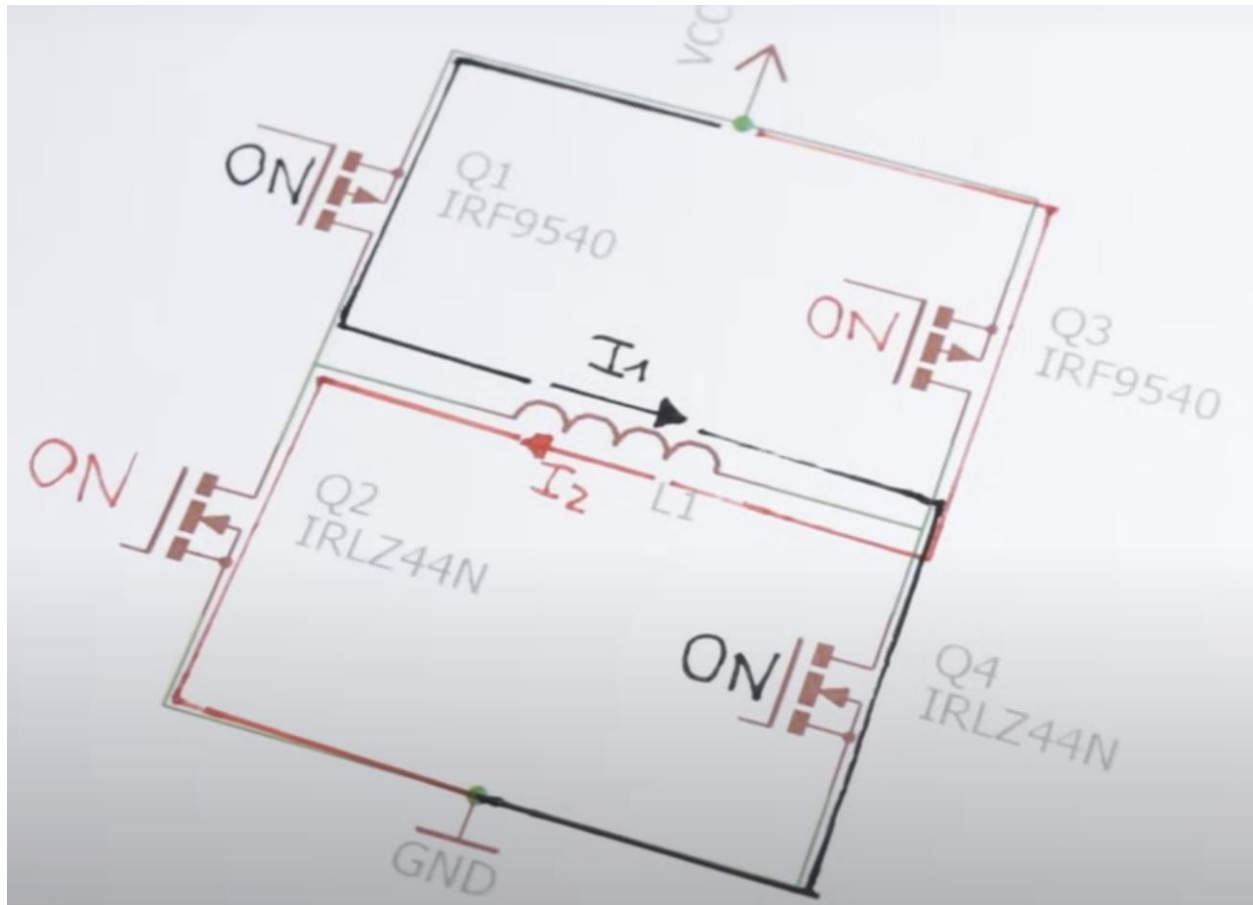

Fig: mosfets schematic diagram in breadboard

Microstepping and the A4988 Driver

Microstepping requires a constant current driver such as the A4988, an advanced H-bridge. By configuring its pins and supplying power, microsteps are generated via a square wave signal from a 555 timer circuit. This results in smoother operation, lower noise levels, and enhanced precision.

Fig : ckt diagram for A4988 motor driver stepper

Microstepping improves stepper motor performance by providing smoother motion, quieter operation, and higher resolution. Stepper motors offer reliable positioning without feedback systems and are optimized using advanced drivers. Understanding their working principles is crucial for designing efficient motion control systems.