Stepper Motors

Modern stepper motors can operate and be controlled both with and without microcontrollers.
A hybrid synchronous stepper motor includes four permanent magnets with alternating polarities. The rotor has 50 teeth per pole shoe, but these teeth are not perfectly aligned due to an offset design that affects magnetic interaction.
The motor consists of eight physically separated coils; however, only four wires are used for control, effectively creating two active coils at any time. By connecting different wire pairs to power sources, the presenter demonstrates how the rotor aligns with magnetic poles through sequential activation.
Each complete cycle of activating the coils results in one tooth moving into position; thus, 200 steps per rotation are calculated based on the motor's specifications.
A simple driver circuit is created using H bridges and an Arduino for controlling coil activation, allowing precise movement of the rotor.
There are various driving techniques such as wave driving (one coil active), full-step driving (both coils active), and half-step driving (a combination of states for increased resolution).
Microstepping is introduced as a method to achieve even finer control over movement by varying current strength rather than applying a constant voltage.
The A4988 microcontroller IC is used as an advanced solution for managing stepper motor operations through variable frequency square waves generated by a timer circuit.
Micro-stepping leads to smoother motion and reduced noise from the motor compared to traditional methods.