Engineering: how stepper motors work

Engineering

This process is repeated in the same manner at the south and west electromagnets UN I we once again reach the star Eng poss. on. Figure 1 In the above example, we used a motor with a resole on of 90 degrees or demonstrate on purposes. In reality, this would not be a very Para cal motor for most applicant ones. The average stepper motor's resole on the amount of degrees rotated per pulse Is much higher than this. For example, a motor with a resole on of 5 degrees would move Its rotor 5 degrees per step. Thereby requiring 72 pulses (steps) o complete a full 360 degree Rota on.

You may double the resole on of some motors by a process known as " half-stepping". Instead of switching the next electromagnet in the Rota on on one at a me, with half stepping you turn on both electromagnets, causing an equal a arc on between, thereby doubling the resole on. As you can see In Figure 2, in the first poss. on only the upper electromagnet is AC eve, and the rotor is drawn completely to it. In poss. on 2, both the top and right electromagnets are AC eve, causing the rotor to poss. on itself between the two AC eve poles.

Finally, in poss. on 3, he top magnet Is Decca voted and the rotor Is drawn all the way right. This process can then be repeated for the en re Rota on. Figure 2 There are several types of stepper motors. 4-wire stepper motors contain only two electromagnets, however the opera on Is more complicated than those with three or four magnets, because the driving cult must be able to reverse the current a re each step. For our purposes, we will be using a 6-wire motor. Unlike our example motors which rotated 90 degrees per step, real-world motors employ a series of mini-poles on the stator and rotor to Increase resole on.

Although this may seem to add more complexity to the process of driving the motors, the opera on Is Eden cal to the simple 90 degree motor we used in our example. An example of a mull pole motor can be seen In Figure 3. In poss. on 1, the north pole of the rotor's permanent magnet is aligned with the south pole of the stator's electromagnet. Note that mull pile post ones are aligned at once. In poss. on 2, the upper electromagnet Is Decca voted and the next one to its immediate el is AC voted, causing the rotor to rotate a precise amount of degrees.

In this example, a re eight steps the sequence repeats. Figure 3 The specific stepper motor we are using for our experiments (EST.: AVID, 5 degrees per step) has 6 wires coming out of the casing. If we follow Figure 5, the 1 OFF the coils, and that the coil windings are connected in pairs. This is true for all four- phase stepper motors. Figure 5 However, if you do not have an equivalent diagram for the motor you want to use, you can make a resistance chart to decipher the mystery connections.

There is a 13 ohm resistance between the center-tap wire and each end lead, and 26 ohms between the two end leads. Wires originating from separate coils are not connected, ND therefore would not read on the ohm meter. First Stepper Circuit Figure 4 is the schema c of our first test circuit. The EPIC'S output lines are first buffered by a 4050 hex buffer chip, and are then connected to an NP transistor. The transistor used, TIPPET, is actually a NP Darlington (it is shown as a standard NP).

The TIP g's act like switches, AC VA Eng one stepper motor coil at a Figure 4 Due to a induced eve surge created when a coil is toggled, a standard 1

NANNY diode is usually placed across each transistor as shown in the figure, providing a safe ay of dispersing the reverse current without damaging the transistor. Some mess called a snubbing diode. The TIPPET transistors do not need an external snubbing diode because they have a built in diode. So the diodes shown in the drawing are the internal diodes in the TIPPET transistors.

The simplest way to operate a stepper motor with a PICK is with the full step pa erne shown in Table 1. Each part of the sequence turns on only one transistor at a me, one a re the other. A re the sequence is completed, it repeats infinitely UN I power is removed. SQ + Table 1 SQ + - I purposely made this first program as small as possible, simply to demonstrate how easy it is to control a stepper motor. Also note the use of high and low commands to control the output lines, rather than peek and poke ROR ones. For our purposes, high and low are sufficient.