Singapore Polytechnic
School of Electrical and Electronics Engineering
ET0104 Embedded Computer Systems DECC 3FT/4EO

Tutorial 6 Stepper Motor

1. SM has a rotating permanent magnet and stator coils energized externally. It is easy to control digitally.

   Full step, one phase on: turn on one phase at one time.
   Full step, two phase on: turn on two phases at a time. Torque increase
   Half step: turn on one phase, then 2 phases, then one phase,etc resolution increases by 2 .
   Microstepping: vary the current in the phases that are on

   Speed control problems:
   Non-synchronisation: when the stepping pulse is too high, the motor may not rotate in synchronisation with the pulse rate, it may stall.

   Resonance: at certain speed, the motor may vibrate or even rotate in reverse by itself.

2. 2*360deg/sec=720 deg/s. 720deg/s /3.6 deg=200/s. That is 200 pulse per second.
   12*360 deg/60 sec=72 deg/s. 72 deg/s/3.6 deg=20 steps/s, pulse period=50ms.

3. Full step:

Step	E (D4)	D (D3)	C (D2)	B (D1)	A (D0)	VALUE
1	0	0	0	0	1	01H
2	0	0	0	1	0	02H
3	0	0	1	0	0	04H
4	0	1	0	0	0	08H
5	1	0	0	0	0	10H

Half step:

Step	E (D4)	D (D3)	C (D2)	B (D1)	A (D0)	VALUE
1	0	0	0	0	1	01H
2	0	0	0	1	1	03H
3	0	0	0	1	0	02H
4	0	0	1	1	0	06H
5	0	0	1	0	0	04H
6	0	1	1	0	0	0CH
7	0	1	0	0	0	08H
8	1	1	0	0	0	18H
9	1	0	0	0	0	10H
10	1	0	0	0	1	11H

Reverse : start from bottom in both cases.

4. The ‘second’ hand of a watch moves 6° (360/60) per movement. (Please note that ‘seconds’ as used in this question refers to the angular distance moved - there is *no* relation to the actual time taken) But the stepper motor only moves 1.8° so it cannot step 6°. To compensate, we step the motor so that every 3 ‘seconds’ it rotates 3-3-4 steps, corresponding to 5.4°+5.4°+7.2° - a total of 18° which is the angle covered in 3 ‘seconds’.