Stepper Motor Lecture
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Overview

• How Stepper Motors Work
• Modes of Operation
• Types of Stepper Motors
• Identifying the Stepper Motor Type
• Drive Circuits
How Stepper Motors Work

• Consist of:
  – Several Coils
  – Permanent Magnet Rotor

• Operate by turning coils on in succession

• Available Step Sizes:
  90°, 30°, 15°, 7.5°, 3.6°, 1.8°, 0.72°

http://eio.com/step-rot.html
Modes of Operation

- Full Step Mode
- Half Step Mode
- High Torque
  - Provides 50% more torque
  - Uses twice as much current

http://eio.com/step-rot.html
Types of Stepper Motors

- **Unipolar**
  - Winding has Center Tap

- **Bipolar**
  - No Center Tap

http://www.cs.uiowa.edu/~jones/step/types.html
Type Identification

- Identify by the number of wires
  - 4 wires : Bipolar
  - 5 wires : 4 Phase Unipolar
    - Single Power Wire
  - 6 wires : 4 Phase Unipolar
    - Dual Power Wires
Drive Circuits

• Made with Discrete Transistors
  – Higher power rating
  – Uses a minimum of 4 I/O pins
  – Larger software overhead

• Stepper Motor Driver IC
  – Lower current capacity
  – Uses a minimum of 2 I/O pins
  – Minimal software overhead
  – Built-in failure diagnostics
Discrete Drive Circuit

• Composed of Transistors and Diodes

• Unipolar Drive Circuit

http://www.cs.uiowa.edu/~jones/step/circuits.html
Discrete Drive Circuit

• Bipolar
  – H-Bridge circuit
Stepper Motor Driver IC

- **Allegro 3977**
  - $V_{\text{max}} = 35\text{V}$
  - $I_{\text{max}} = 2.5\text{A}$
- Micro-stepping ability
- Home Position
- Sleep State
  - Minimize power consumption during idle states
Questions?