ECE0202: Embedded Systems and Interfacing
Lab 5: Stepper Motor Control (in assembly)
Due April 3rd 11:59 pm

Objectives

- **Use full stepping to control the speed and position of a stepper motor**
- **Generate pulse waveforms to control a stepper motor**
- **Use Darlington transistor arrays to perform high-current driving with extremely low input current**

Pre-Lab Reading

- **Read Textbook Chapter 16: Stepper Motors**
- **Watch the following video tutorials (credit to pcbheaven):**
  - http://www.youtube.com/watch?v=MHdz3c6KLrg
  - http://www.youtube.com/watch?v=t-3VnLadIbc
- **Answer the pre-lab questions**

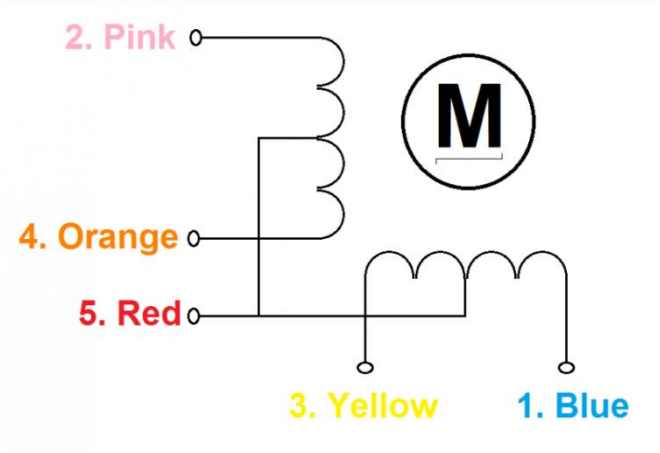
Deliverables

- **(40 points) Basic requirement: Code that operates a simulated "windshield wiper" on the stepper motor.**
  - **When the on-board button is held down, the stepper motor will rotate approximately 145° counterclockwise, then 145° clockwise, then repeat over and over. When the button is released, the "windshield wiper" should finish its current routine and stop when it returns to 0°.**
- **(10 points) Answers to the pre-lab questions. Indicate how each group member participates and contributes to the lab at the end of the lab report.**
- **(50 points) A demonstration of the operational circuit to an instructor or TA.**
- **10 points extra credit: Display the degree and turning direction of the motor in real time on the Tera Term.**

Please submit your code as *.s files

Based on a lab from ECE271 at the University of Maine by Yifeng Zhu.

Stepper Motor Overview



Motor model	**28BYJ-48**	Number of phases	2
Rated voltage	5V DC	Geared reduction ratio	1/64
DC resistance per phase	50Ω±7%(25℃)	Pull in torque	>300gf.cm / 5VDC 100pp

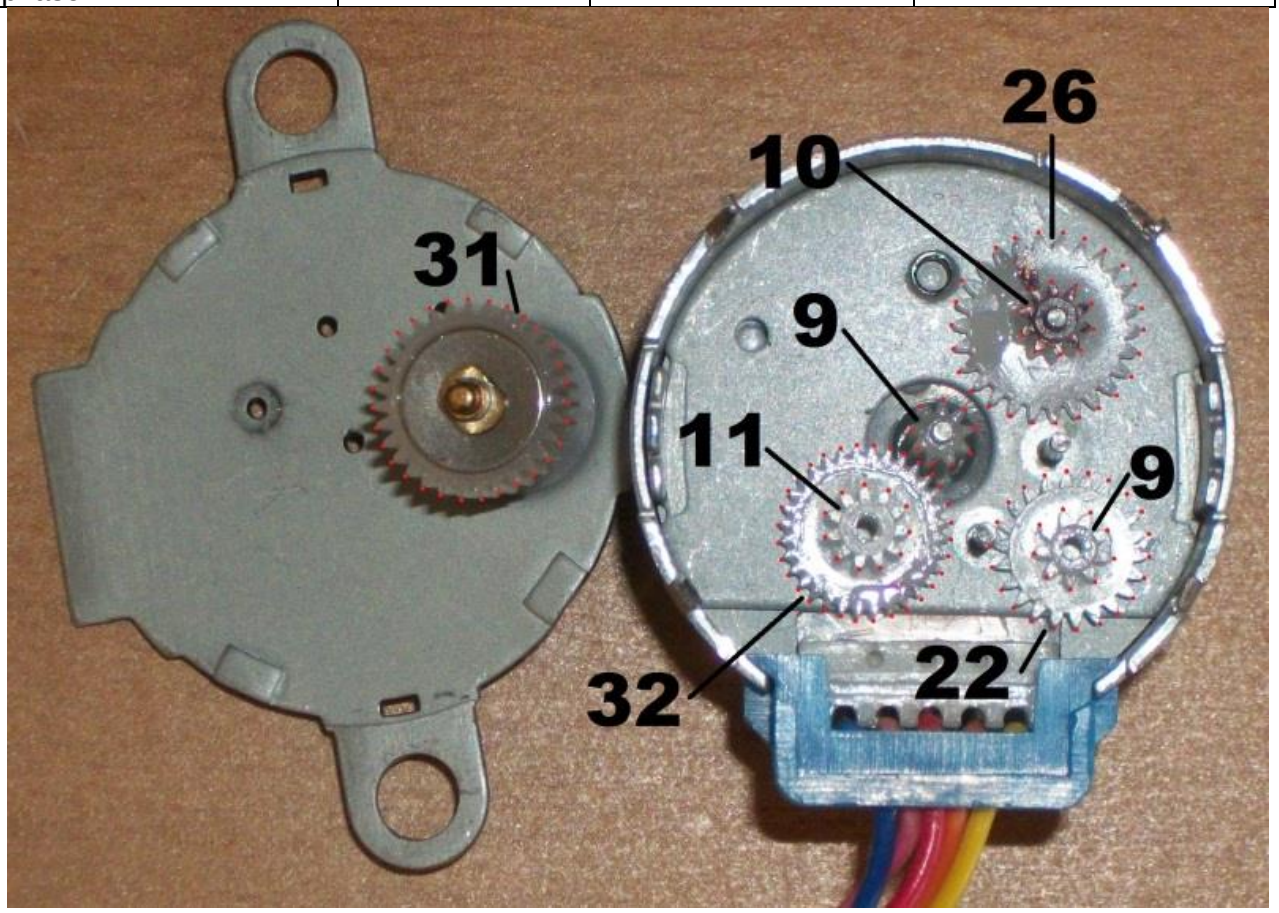


image from *forum.arduino.cc*

The gear ratio is:

$$\frac{31 \times 32 \times 26 \times 22}{11 \times 10 \times 9 \times 9} = 63.68395$$

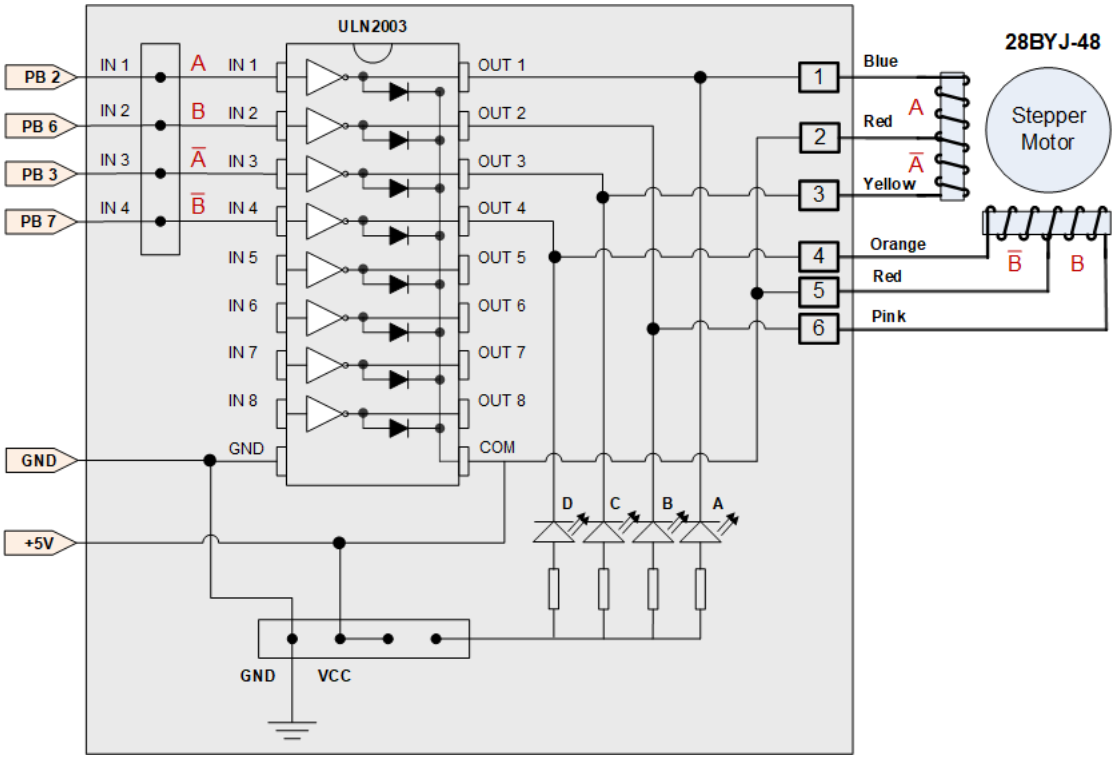
Full-stepping

- Internal motor: 32 steps per revolution
- Great reduction ratio: 1/63.68395, approximately 1/64
- So it takes $32 \times 64 = 2048$ steps per revolution for the output shaft

Half-stepping

- Internal motor: 64 steps per revolution
- Great reduction ratio: 1/63.68395 ≈ 1/64
- So it takes $64 \times 64 = 4096$ steps per revolution for the output shaft

Interfacing the stepper motor requires four pins. We select the following four pins to control the stepper motor: PB2, PB3, PB6, and PB7. The textbook provides a connection diagram for stepper motor Mabuchi #PF35T, which is very similar to the diagram below.

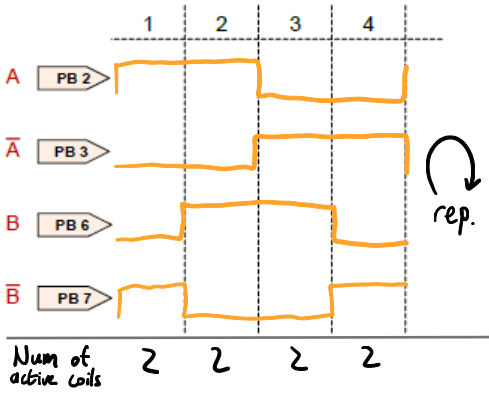


Pre-Lab Questions

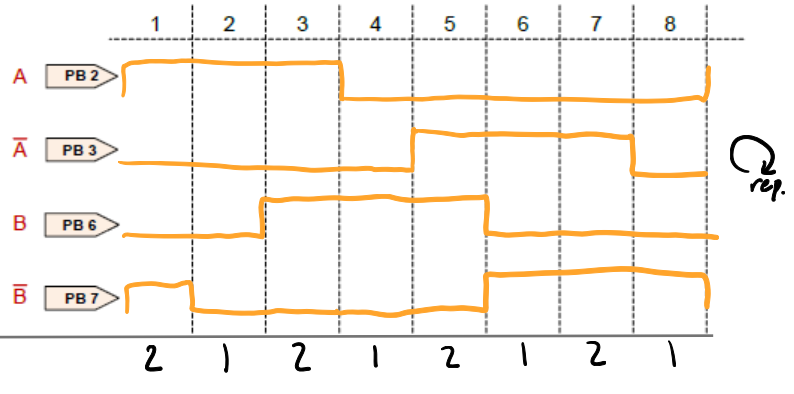
1. Fill out the following timing diagrams for the GPIO outputs that create a full-stepping sequence and a half-stepping sequence.

Refer to Figure 16-10 and 16-12 of textbook to complete the following two diagrams.

Full stepping sequence



Half stepping sequence



2. How would you change your code to vary the rotation speed of the stepper motor?

Vary the delay between time steps

3. How would you reverse the rotation direction of the stepper motor?

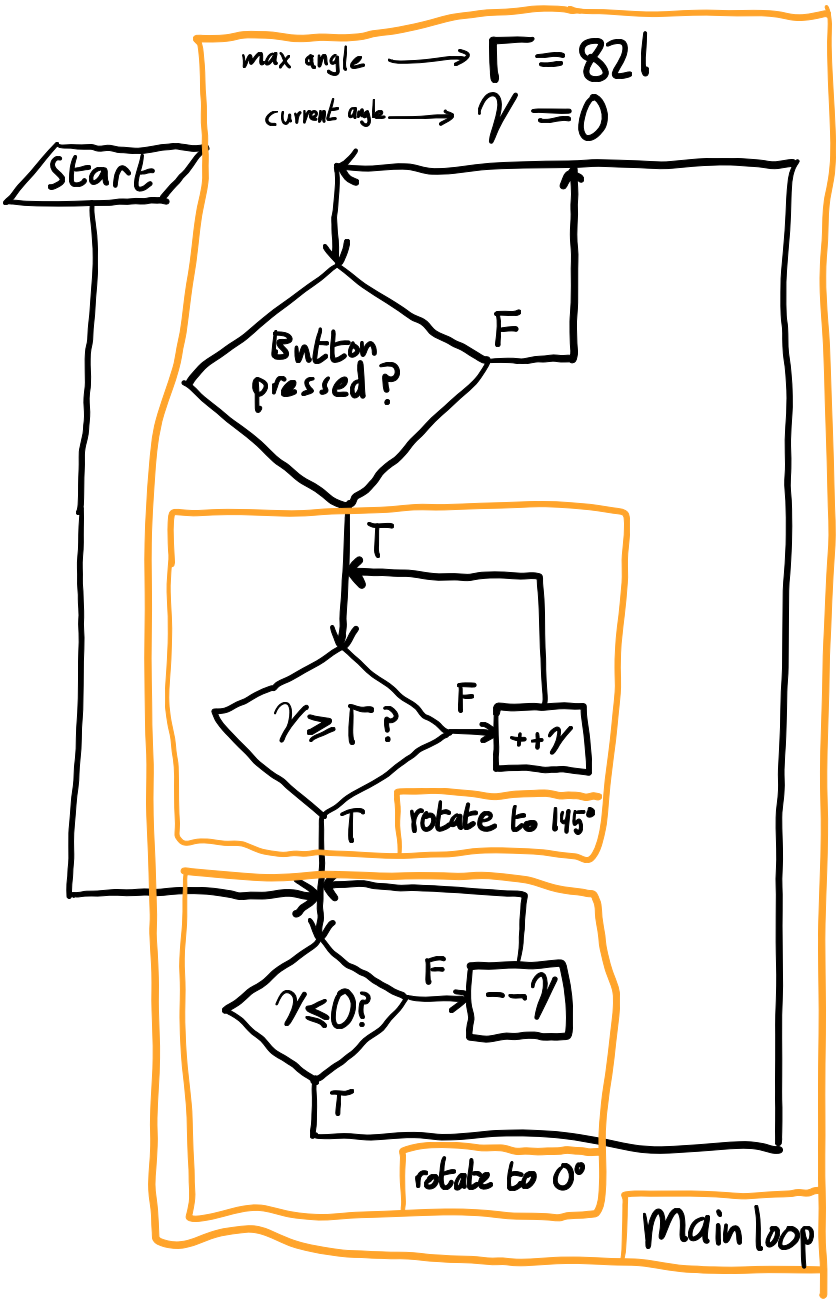
reverse the stepping sequence

Participation and Contribution

Please indicate the participation and contribution for each group member using the following table.

Name	Participation and Contribution

Flow Chart



~2038 steps/rotation
360°

$\frac{2037}{360°} = \frac{\Gamma}{145°}$

$\Gamma \approx 821$