**Lab No.**

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<th>Lab Title</th>
<th>Semester</th>
<th>Session</th>
<th>Lab Durations</th>
<th>Independent Studies</th>
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<td>12</td>
<td>Stepper Motor</td>
<td>02</td>
<td>2015/16</td>
<td>2 Hours</td>
<td>1 Hour</td>
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**Electronic Engineering Laboratory IV**

**BEE31101**

**Instruction Sheet**
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1.0 Outcomes

After completing this module, student should be able to:
1. Relate the appropriate assembly language for applications related to stepper motor. (C3, PS)
2. Organize time management in group effectively according task given. (P5, TS)
3. Adapt the current technology in microcontroller with morale and etiquette. (A4, ET)

2.0 Guidelines

1. Grouping: Lab group is not predetermine and consists with at most two team members.

2. Pre-Lab: Must be handwritten and submitted to the instructor at the beginning of lab session.
   Verified by the instructor and returned to the students at the end of lab session. The verified
   pre-lab will be attached with the final report for submission.

3. Lab Activities: All lab activities such as sample code, examples and lab assignments must
   be held in the respective lab location and completed within the given times.

4. Demonstration: Student must demonstrate the successful sample code, examples and lab
   assignments to the respective instructor. Verification only will be given upon completion of all
   lab activities and initialized by the instructor on the cover page.

5. Report Organization: Report must be organized according to given report template.

6. Appendix: Printed source code with detail description of each command for lab activities.

7. Report Submission: Report must be received by respective technical staff (at respective
   lab) before 4.00pm; not later than three (3) days upon completion of lab session.
3.0 Pre-Lab (5%)

1. State two differences between DC motor and stepper motor.  

   (3 marks)

2. Why L293D shall be placed between the microcontroller and the stepper motor?  

   (2 marks)
4.0 Procedures

Stepper Motor Overview

A stepper motor is a widely used device that translates electrical pulses into mechanical movement. In applications such as disk drives, dot matrix printers, PCB drilling mill, camera panning system, automatic fish feeder, and robotic, the stepper motor is used for position control.

HOW STEPPER MOTOR WORKS?

Stepper motors are very different from a regular DC motors. Instead of spinning like DC motors do, stepper motor steps at a specific resolution for each pulse. The motor that we are using needs 48 steps or pulses to complete a single revolution. That should be enough to tell about its precision. Another advantage of stepper motors is the fact that their speed of rotation can be achieved almost instantly even if you change the spinning direction. Stepper motor consists of a rotor - the permanent magnet that rotates inside, and stator - four coils (north, east, south, west) that are part of the case, and which don't move. Rotor can be moved by sequentially applying a pulsed DC voltage to one or two coils at a time.

STEPPER MOTOR DRIVER

Microcontroller cannot directly control the stepper motor using its pins. Most of the microcontroller output pins have small amount of current usually in milliampere. In able to move the rotor you will need a driver. Driver is a circuit that applies a voltage with high milliampere to any of the four stator coils. Driver can be built with IC such as ULN2003, L293D (refer to Figure 5), four Darlington transistors or four power transistors such as 2N3055.

STEPPER MOTOR CONNECTIONS

Table 1 shows a bipolar stepper motor connected to the driver L293D. The rotation of the motor can be determine as in the table below. + sign equal to active HIGH and – sign equal to active LOW.

<table>
<thead>
<tr>
<th>Bipolar Drive</th>
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<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>red</td>
</tr>
<tr>
<td>1</td>
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Table 1: Stepper motor stepping sequence.
5.0 Lab Activity (15%)

Lab Activity 1

Part A

Figure 1: PIC16F877A with stepper motor Quadruple Half-H driver (L293D)

Stepper motor source code

```
PORTB EQU 06h ; Address of PORTB
TRISB EQU 86h ; This tells the assembler where the address of ports direction of
STATUS EQU 03h ; Bit 6 and 5 for bank selection in STATUS register.
RP1 EQU 6 ; To select bank 0, RP1 = 0 and RP0 = 0 {PORTA and PORTB}
RP0 EQU 5 ; To select bank 1, RP1 = 0 and RP0 = 1 {TRISA,TRISB & ADCON1}
; To select bank 2, RP1 = 1 and RP0 = 0
; To select bank 3, RP1 = 1 and RP0 = 1

d1 EQU 11h ; Set variable d1 to register address 11h

ORG 00h
BSF STATUS,RP0 ; Select bank 1 (To access TRISB and TRISC)
MOVLW B'00000000' ; 00000000 is loaded into W register
MOVWF TRISB ; Setup PORTB as OUTPUT
```
Figure 2: Program to control rotation of stepper motor

1. Figure 1 illustrates schematic connection of stepper motor using PIC16F877A.
2. Figure 2 show the assembly program to control the rotation of stepper motor.
3. Debug the program using MPLAB and simulate the control of stepper motor using Protues software.
4. Record your observation.  

5. Demonstrate your solution to instructor.  

Part B
1. Modify the program in Figure 2 to rotate the stepper motor in clockwise direction.
2. Debug the modified program using MPLAB and simulate the operation using Protues software.  

3. Record your observation and demonstrate your solution to instructor  

Lab Activity 2
1. Modify the program in Figure 2 and use a push button to control the operation of stepper motor. When the button is pressed, the stepper motor working; else it stops functioning.
2. Debug the program using MPLAB and simulate the operation using Protues software.

(15 marks)
3. Record your observation and demonstrate your solution to instructor (5 marks)

7.0 Observations (15%)

1. Analyze and discuss the outcome of Proteus simulation for Lab Activity 1 PART A. (5 marks)

2. Discuss the process to control the rotation direction for the stepper motor. (5 marks)

3. From Lab Activity 2, modify the code to select fast or slow rotation using BUTTON1. (5 marks)

8.0 Question (15%)

1. What are the 4-step sequence of the stepper motor in Figure 2? Discuss how the sequence affect the rotation direction for a stepper motor. (5 marks)

2. Show the normal 4-sequence clock counterclockwise if the first step is 1001. (2 marks)
3. What is the effect of a time delay between issuing each step?  

(3 marks)

4. How to increase and reduce the rotation speed of stepper motor?  

(5 marks)

Conclusion

References