**ENGG1100 Introduction to Engineering Design**

**Faculty of Engineering**

**The Chinese University of Hong Kong**

**Laboratory 4: Sensors and Actuators**

**Lab Sheet and Report**

Group No: \_\_\_\_\_\_\_\_\_\_\_\_, Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student 1:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(SID)\_\_\_\_\_\_\_\_\_\_\_\_\_ ; Student 2:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(SID)\_\_\_\_\_\_\_\_\_\_\_\_\_

After your group has completed this lab work, demonstrate your results to the tutor and ask the tutor (TA) to sign below. Submit this sheet to the tutor within one week after this laboratory session finishes.

Name of the tutor/ signature of the tutor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ /\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Experiment 4-1.1**Step 5

|  |  |
| --- | --- |
| Magnet (White) | Output, D18 (Red LED) |
| Distance:Angle: |  |

Step7

|  |  |
| --- | --- |
| Magnetic strip | Output, D18 (Red LED) |
| Distance:Angle: |  |

|  |
| --- |
| Question: What positions you should adopt to detect the magnetic strip and the soft drink can in your project? |

**Experiment 4-1.2**Step 5

|  |  |
| --- | --- |
| Input | Results |
| Switch handle position | D16 (Red LED) | D15 (Green LED) |
| Leave the handle at normal position. |  |  |
| Press the handle down. |  |  |

|  |
| --- |
| Question: Describe the implication of this change. |

**Experiment 4-2.1**Steps 3 and 4

|  |  |
| --- | --- |
| Input | Results |
| Sensor-1 | Motor direction  | D1 (Green) | D2 (Green) | D3 (Red) | D4 (Red) |
| Connect 5V toTP1; Connect GND to TP2 |  |  |  |  |  |
| Connect 5V toTP2; Connect GND to TP1 |  |  |  |  |  |

|  |
| --- |
| Question: Describe the relationship between the rotating direction of the motor and the power supply’s polarity (or direction of current flow). |

**Experiment 4-2.2**Steps 5, 6 and 7

|  |  |
| --- | --- |
| Inputs | Results |
| SW1 | SW2 | SW3 | SW4 | DC Motor | CC LED(on/off) |
| Current flow direction | Rotation direction |  |
| UP | UP | UP | UP | - |  |  |
| UP | UP | UP | DOWN | - |  |  |
| UP | UP | DOWN | UP | - |  |  |
| UP | UP | DOWN | DOWN | - |  |  |
| UP | DOWN | UP | UP | - |  |  |
| UP | DOWN | UP | DOWN |  |  |  |
| UP | DOWN | DOWN | UP |  |  |  |
| UP | DOWN | DOWN | DOWN |  |  |  |
| DOWN | UP | UP | UP | - |  |  |
| DOWN | UP | UP | DOWN |  |  |  |
| DOWN | UP | DOWN | UP |  |  |  |
| DOWN | UP | DOWN | DOWN |  |  |  |
| DOWN | DOWN | UP | UP |  |  |  |
| DOWN | DOWN | UP | DOWN |  |  |  |
| DOWN | DOWN | DOWN | UP |  |  |  |
| DOWN | DOWN | DOWN | DOWN |  |  |  |

|  |
| --- |
| Question: Which switching state combination(s) of the switches may be useful in your project? |

**Experiment 4-2.3**Steps 8 and 9

|  |  |
| --- | --- |
| InputsJ4= M-D; J5=M-D  | Results |
| EN1 | 1A | 2A | 1Y | 2Y | D7 | D8 | Current flow |
| H | H | H |  |  |  |  |  |
| H | H | L |  |  |  |  |  |
| H | L | H |  |  |  |  |  |
| H | L | L |  |  |  |  |  |
| L | H | H |  |  |  |  |  |
| L | H | L |  |  |  |  |  |
| L | L | L |  |  |  |  |  |
| L | L | L |  |  |  |  |  |

Step-10.

|  |
| --- |
| Logic level of 1Y and 2Y when EN1 down. |

|  |
| --- |
| Question: Describe the relationship between the motor’s current flow, rotation direction and the driver inputs’ combinations. Which input combinations can drive the motor run or stop? |

|  |
| --- |
| Question: What is the implication, when EN1=low and we touch the M1 or M2 pin? |

**Experiment 4-2.4**Steps 5-8 (M1=H-M; M2=D-M)

|  |  |
| --- | --- |
| InputsM1=H-M; M2=D-M  | Results |
| EN1 | 1A | 2A | M1 | M2 | D7 | D8 | Current flow |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |
| --- |
| Question: Describe the relationship between the current flow direction and the rotation direction of the motor. |

Step 9 (M1=L-M, M2=D-M)

|  |  |
| --- | --- |
| InputsM1=L-M, M2=D-M  | Results |
| EN1 | 1A | 2A | M1 | M2 | D7 | D8 | Current flow |
| H | H | H |  |  |  |  |  |
| H | H | L |  |  |  |  |  |
| H | L | H |  |  |  |  |  |
| H | L | L |  |  |  |  |  |
| L | H | H |  |  |  |  |  |
| L | H | L |  |  |  |  |  |
| L | L | L |  |  |  |  |  |
| L | L | L |  |  |  |  |  |

|  |
| --- |
| Question: Describe the relationship between the current flow direction and the rotation direction of the motor. |

Step 10 (M1=D-M, M2=L-M)

|  |  |
| --- | --- |
| InputsM1=D-M, M2=H-M  | Results |
| EN1 | 1A | 2A | M1 | M2 | D7 | D8 | Current flow |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |
| --- |
| Question: Describe the relationship between the current flow direction and the rotation direction of the motor. |

Step 10 (M1=D-M, M2=H-M)

|  |  |
| --- | --- |
| InputsM1=D-M, M2=L-M  | Results |
| EN1 | 1A | 2A | M1 | M2 | D7 | D8 | Current flow |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |
| --- |
| Question: Describe the relationship between the current flow direction and the rotation direction of the motor. |

|  |
| --- |
| Question: Suggest a solution of using L293D to control the motors in your project. Which motor(s) needs bi-directional motion and which motor(s) needs unidirectional motion only? How to control them to perform the given tasks? |

**Experiment 4-2.5**

|  |
| --- |
| Question: Suggest the sequence of the switch setting to grip and release the can for your project. |

 |