The Chinese University of Hong Kong
Department of Computer Science and Engineering
CENG2030 Fundamentals of Embedded System Design

Project 2: Infra-Red (IR) Tracker

Submission Instructions:

- You are required to submit **demo videos**, and **Arduino codes** to Blackboard.
- Create each Arduino project with a project name based on the project and question numbers, e.g. "**ceng2030_pro2**".
- Compress all the files to one single zip/rar file named with your student ID number, e.g. "**1155123456.zip**".
- **Upload the zip/rar file before the deadline as stated in Blackboard**, **10 marks** will be deducted **per hour**

For each question below, you are required to record a short mp4 **video** to demonstrate the answers. In the video, the following elements are required:

A. Show your full name and SID on a paper next to your circuit [10 marks]
B. Voice descriptions in English/Cantonese/Mandarin on what you are doing [10 marks]
C. Demonstrate your works by presenting your system and its outputs [80 marks]

List of components and equipment

- 1x Arduino UNO board
- 2x IR sensor modules
- 1x IR torch (consists of an IR LED, an 100Ω resistor, and a battery holder)
- 1x Servo motor
- 1x Breadboard

1. Introduction

In this project, students are required to implement an infra-red (IR) tracker by using an Arduino microcontroller board. The IR tracker will detect the IR light source, and rotate the sensor module towards the direction of the source automatically (see the demo video). The hardware connection diagram of the IR tracker is shown in Fig. 1.

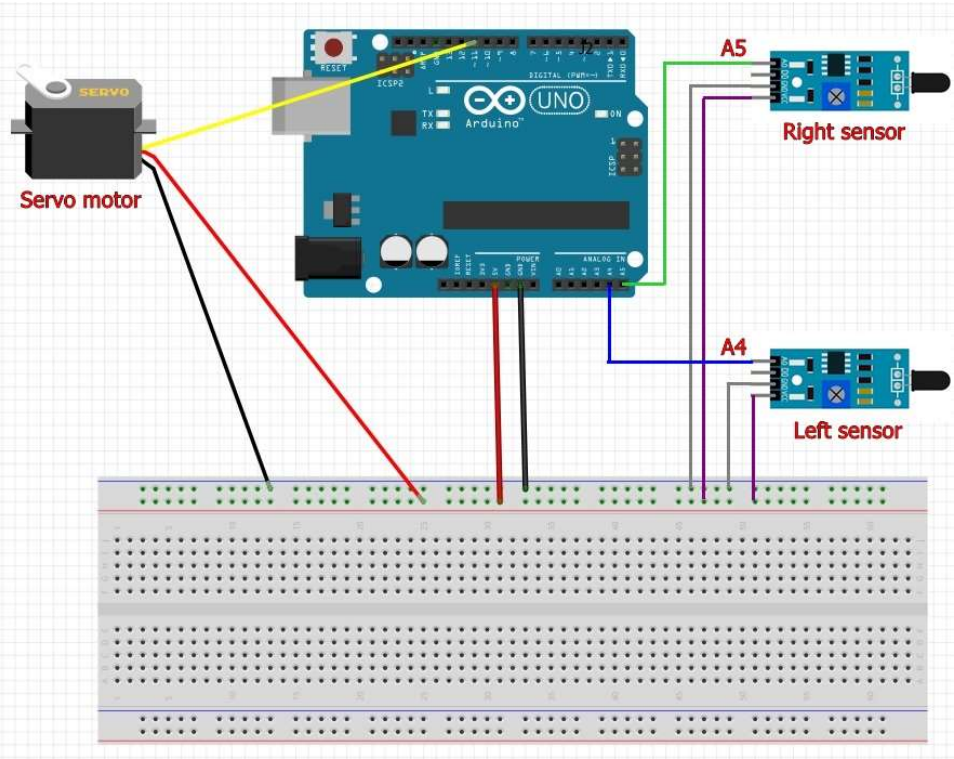


Fig. 1: Hardware connection diagram of the IR tracker

By using the IR sensors (i.e. the left and right sensors), the tracker detect the IR signal emitted from the IR torch which is shown in Fig. 2. The left and right sensors are fixed in the positions with a separation angle of 90 degree as shown in Fig. 3, such that when the IR source is near to the left of the tracker, the signal received by left sensor will be stronger than the signal received by the right sensor. In contrast, when the IR source is near to the right of the tracker the signal received by the right sensor will be stronger than the signal received by the left sensor. When the IR source is at the center of the tracker both left and right sensor will receive approximately the same signal strength.

Fig. 2: IR torch

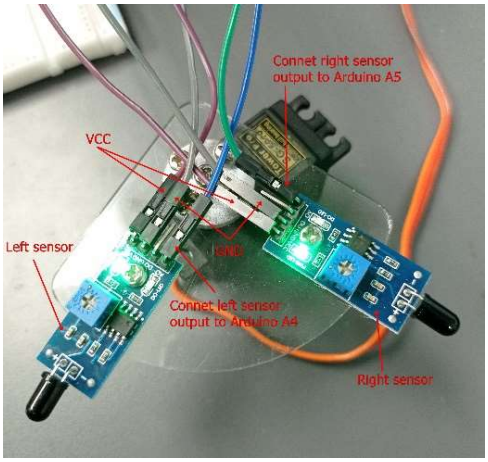


Fig. 3: The position of left and right sensors

2. The Algorithm of the IR Tracking

The algorithm of the IR tracker compares the IR signal strengths received by the left and the right sensors, then control the servo motor to rotate to the direction accordingly. For example, when the left signal is stronger than the right signal, then rotate the servo motor to the left.

To implement a stable control system, we can make use of so-called “dead-band” to prevent the system from oscillation. A dead-band defines a range of signal strength difference as zero. For example, when the difference of the signal strength is less than 20 (i.e. the dead-band = 20), we consider the difference as zero, and therefore we shall not take any action and leave the servo motor at its current position.

Since the servo motor can only rotate 180 degree, so we should also limit the rotation angle of the servo motor in the range of 0 to 180 degree only.

The flow chart of the whole IR tracker program is shown in Fig. 4.

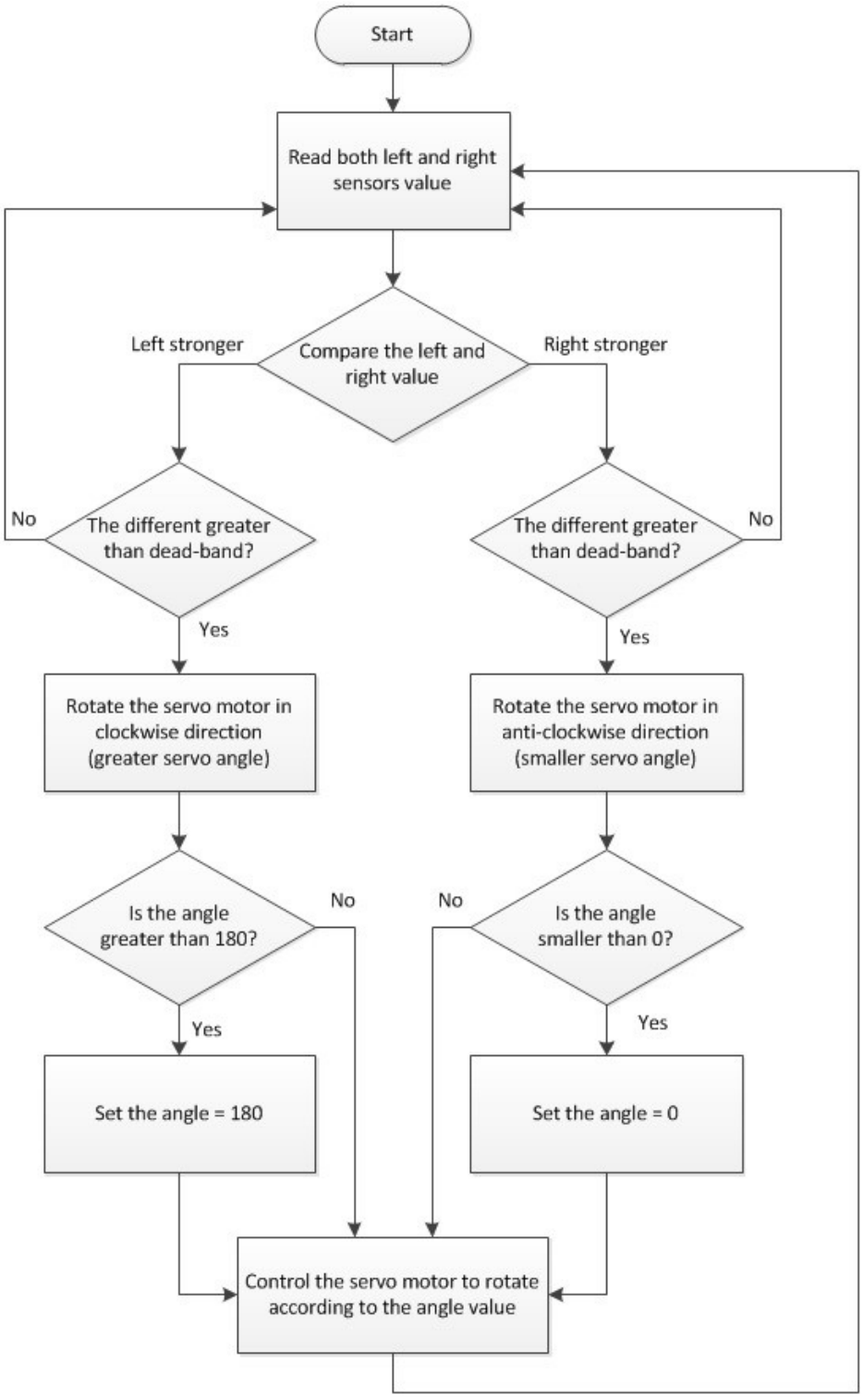
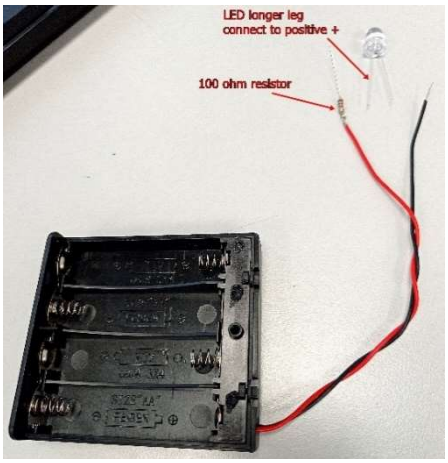


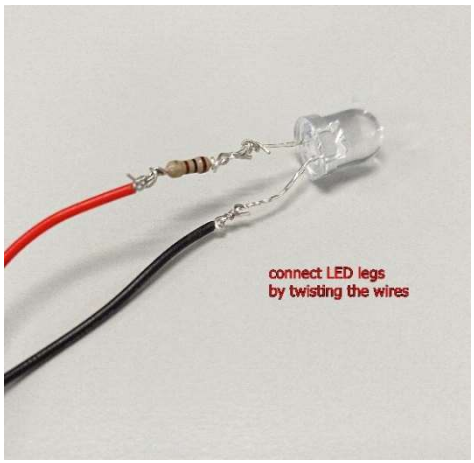
Fig. 4: Flowchart of IR tracker program

3. Constructing the IR Torch and Mounting the IR Sensors

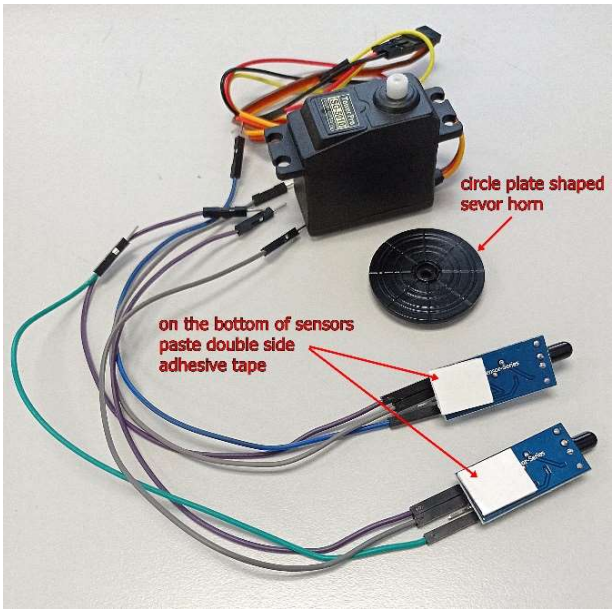
a. **<u>If the IR torch is not yet connected</u>**, prepare the Infra-red (IR) LED, 100 ohm resistor and the battery holder

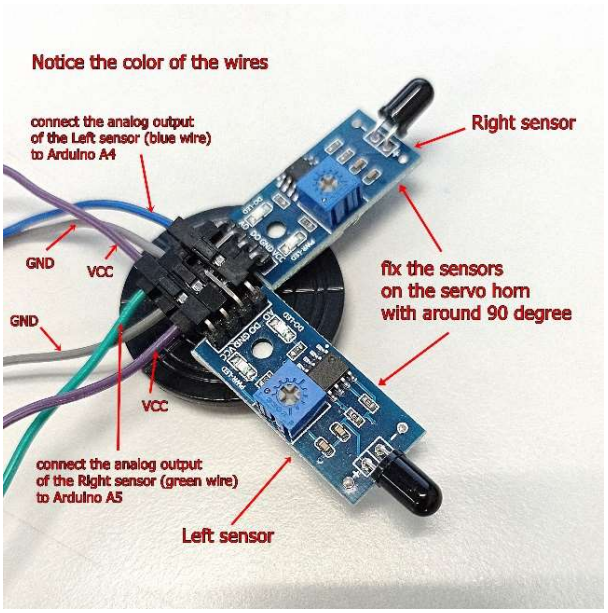


b. **<u>If the IR torch is not yet connected</u>**, connect the components together as shown below.



c. Prepare the servo motor, servo horn and IR sensors, fix the sensors on the servo horn as shown below.





4. Hardware Connections

Plug the acrylic board together with IR sensor modules onto the top of the servo motor. Connect the wires according to the following instructions.

a. Connect the left sensor output (the blue wire) to Arduino pin A4 and connect the right sensor output (the green wire) to Arduino pin A5 as shown in Fig. 5. (use the same color wires as on the picture is recommended)

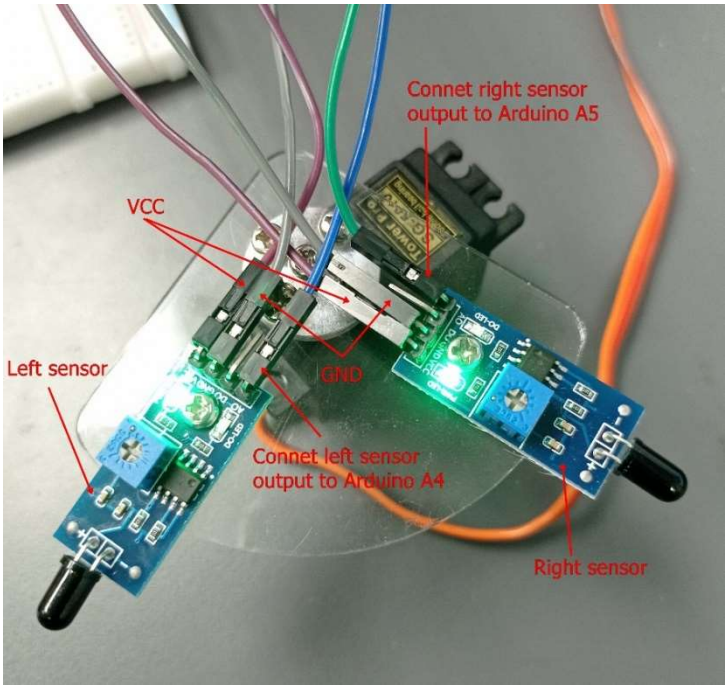


Fig. 5: IR sensor modules connections

b. Connect the servo motor and the sensor modules to Arduino board as shown in the Fig. 6.

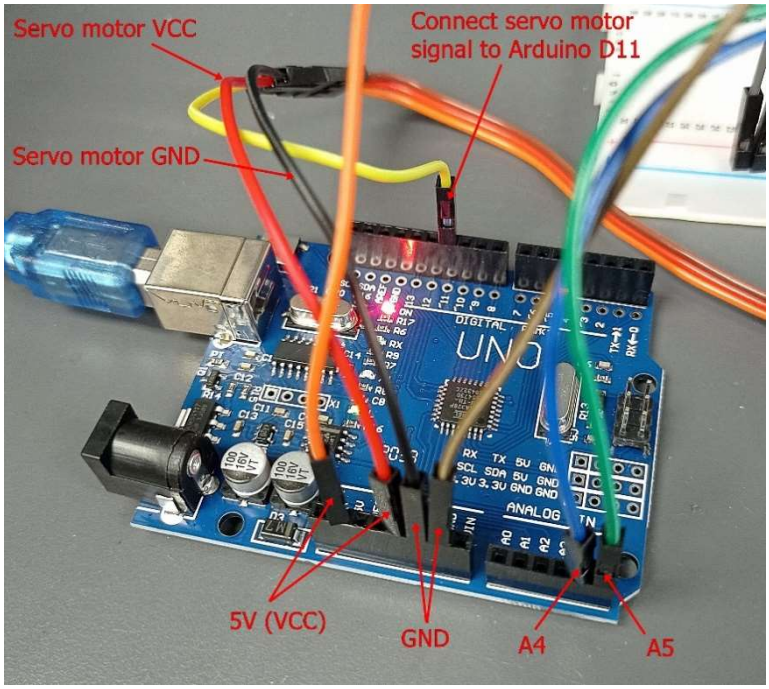


Fig. 6 Connections on the Arduino board

c. Use breadboard to connect the VCC and GND as shown in the Fig. 7.

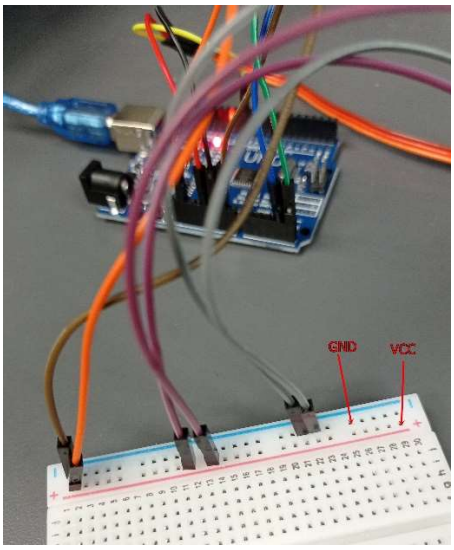


Fig. 7: Connection on the bread board

d. Connect the USB cable to the host computer. The whole system is connected as shown in Fig. 8.

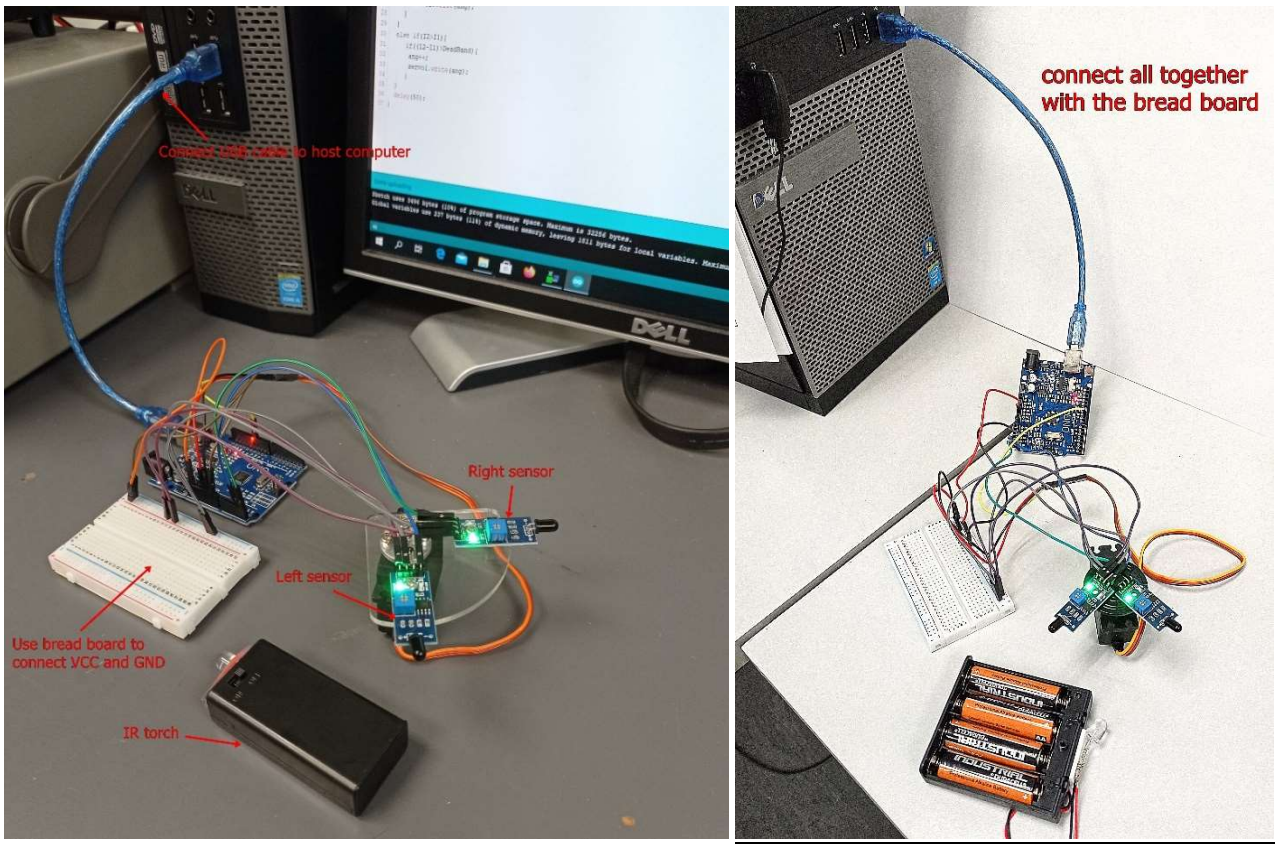


Fig. 8: The whole system connection

e. Test your IR tracker system by turn on the IR torch and put the torch at the left and right side of the tracker.

f. Record a demo video to show your test results.

THE END