



山东大学

崇新学堂

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实 验 报 告

课程名称： 电子信息工程导论

实验名称： A Real Head-Turner

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Pointing Circuit

Check Yourself 1: Complete and verify the circuit on the protoboard

This is the circuit we connected on the lab breadboard, modeled after the circuit in our simulation, with a resistance of 5Ω .

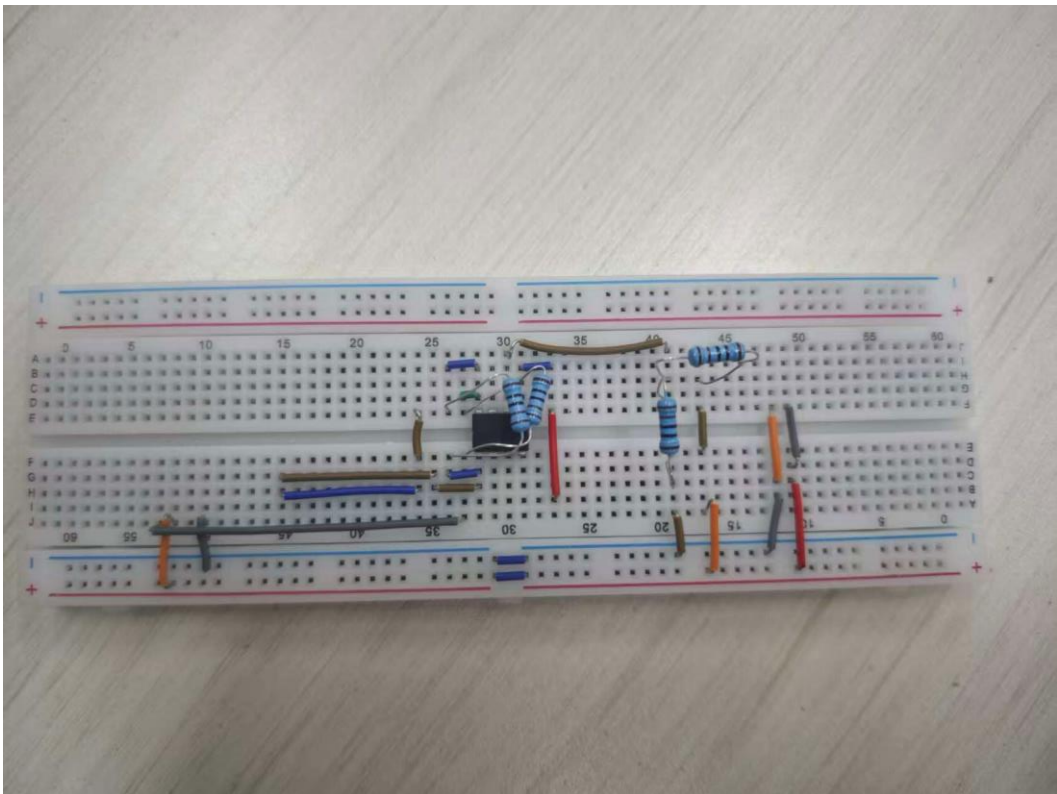


Figure 1 breadboard circuit

Connect the robot connector to the yellow cable coming from the robot.
Connect the head connector to the front connector (near the eyes) of the head using a red cable.

Based on the above connection method, the physical diagram is roughly connected as follows

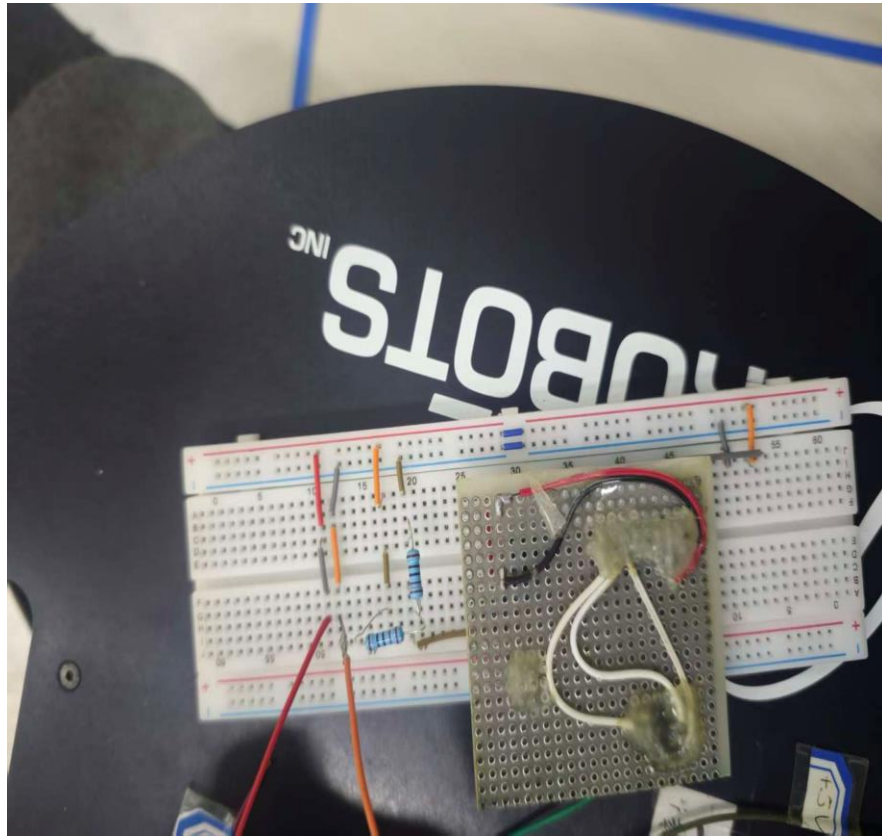


Figure 2 The general connection method of the physical object

Checkoff1: Illustrate the circuit and its performance at two different distances with the two gains.

Declaration:

Due to issues with the vehicle, we cannot obtain real data. We use simulation values for the following analysis and comparison.

The best k_s is shown below

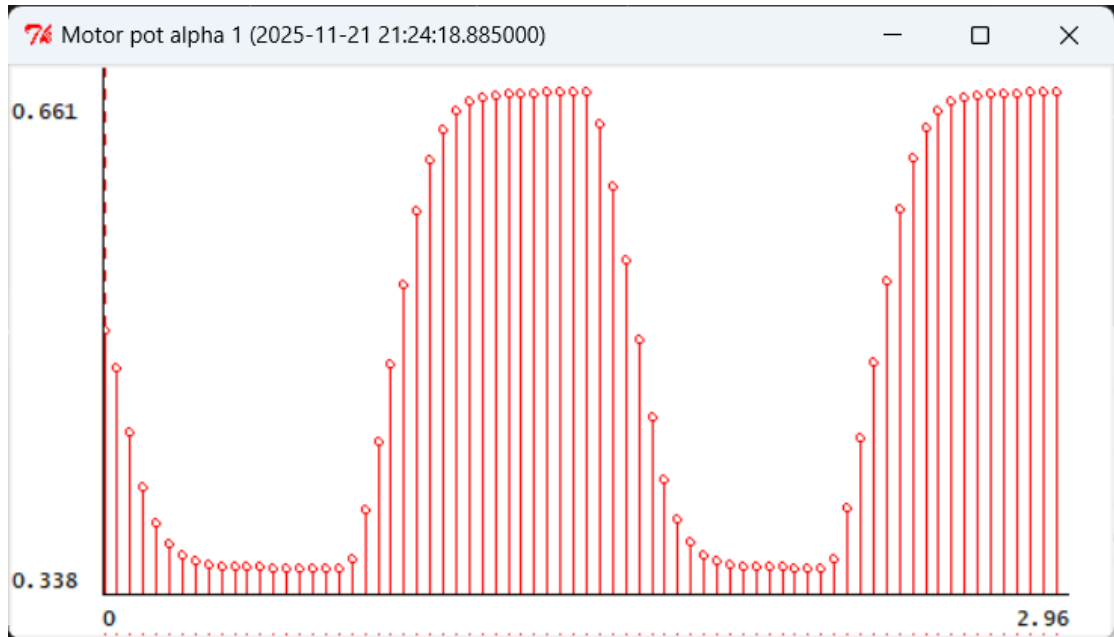


Figure 3 The best k_s corresponding to the image

This is another gain, k_s

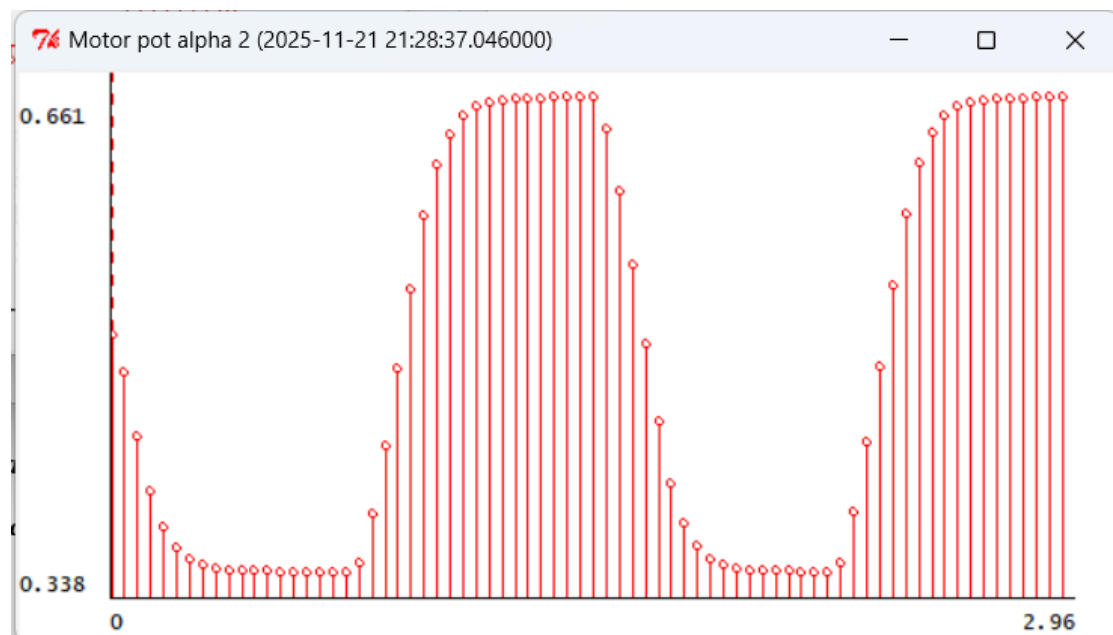


Figure 4 Images corresponding to k_s in the control group

Our result(assumption):

Experimental results demonstrate that increasing either the gain k_c or the distance-dependent sensor sensitivity k_s accelerates the machine

head's response speed, but simultaneously generates more overshoot and oscillation. As shown in the figure, our system currently exhibits some overshoot, indicating an under-damped state. When the distance is too close, resulting in a high k_s , oscillation intensifies and the stabilization time extends. Conversely, when the distance is too far, causing k_s to be low, the response slows down, and the stabilization time increases due to delayed response.

Checkoff 2. Demonstrate the pointing accuracy of our head

Our strategy assumption:

To improve the accuracy, we need to make two improvements:

First, optimize the gain to maximize k_c without causing oscillation, which can reduce the steady-state error.

Second, address the sensor mismatch issue by adjusting the fine-tuning resistors to compensate for the inherent differences between the left and right sensors.

Our explanation for the assumption:

The fundamental limitation of precision stems from the motor's dead zone. When the head approaches the target, the error signal becomes too weak, and the drive voltage fails to overcome the motor's static friction, causing the head to stop before fully aligning. Additionally, sensor noise further restricts the final precision.

Appendix1: Some content description

Since this experiment cannot be conducted on actual vehicles or through simulations, we have made numerous assumptions in the article, relying on intuition and conjecture to address certain questions.

Appendix2: The Description of AI Usage in the Report

Since real testing was not feasible, we employed AI to infer unknown scenarios in this experiment and responded based on its explanations.