Crayfish Stretch Receptor Stimulator

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Introduction

Crayfish stretch receptor is a part of crayfish nervous system and it is able to monitor the movement and the position of crayfish body. Although such labs can be done by manually pulling the crayfish tail, the speeds of stretches are hard to control, and personal errors might be generated in terms of pulling distance. As the result, we need a new pulling way with precise speed and distance control to monitor the operation of crayfish stretch receptor comprehensively. This project is a microcontroller based user controlled interface as the automated crayfish tail receptor stimulator.

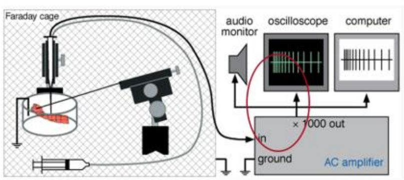


Figure 1 Crayfish lab equipment

Issues

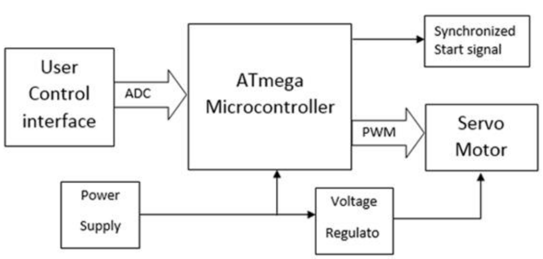
1. New control mechanism

The new automatic stretch stimulator is going to able to set the crayfish tail at certain initial and final position precisely. It could record the distance and drag another time. There is also a reset button, which reset everything back to initial.

2. Electrical noise isolation:

The most important downside is that the electrical servo is quit noisy, and it might reset the microcontroller through powerline. Since the crayfish nerve testing signal is highly sensitive to electrical noise, this problem might be severe if it affects the nerve signal.

Approach



User Control Interface

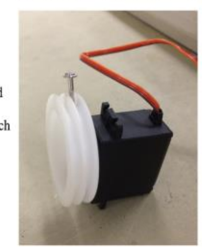
1 power switch, 3 push buttons, 3 knobs, Power LED, sockets for PWM servo and start signal.

Analog to Digital Converter

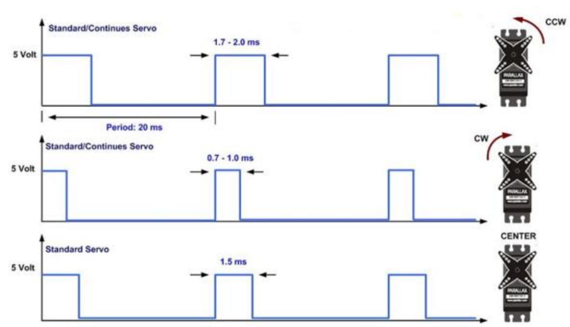
All these position and speed inputs from potentiometer knobs are analog signals. We configured the on chip ADC in order to convert the analog signal to digital. However, we only have one on chip ADC, so we have to mux the inputs and select certain in a particular state.

Servo Motor

We picked a low noise servo motor, which have 180 degree rotation and controlled by the PWM signal. A large wheel was installed on the servo so that we could attach the thread on it.



Pulse Width Modulation



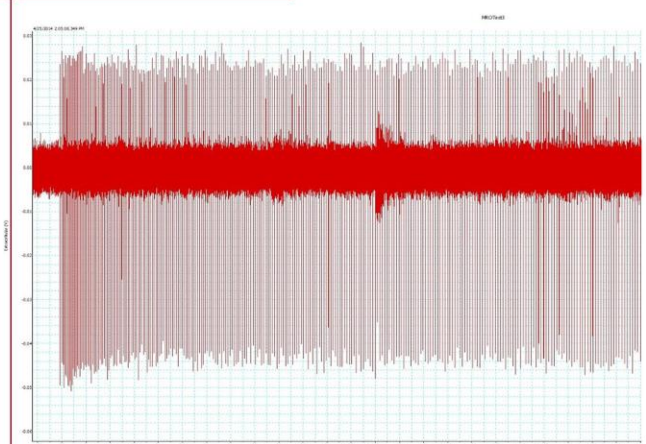
Servo Motor PWM Timing Diagram

We used the 16 bit timer system in microcontroller to generate a PWM signal as above. Base on the testing on our servo, we figured out the conversion from microcontroller digital number to the exact angle we want.

State Mechine

The logic between inputs and outputs are configured by our state machine in microcontroller code. Each of the push button is corresponding to a state transition. And in each state we did one logic design to change the output according to the current inputs.

Result



This waveform shows an example of the Muscle Receptor Organ response to stretch. It activates with an initial high frequency with the stretch and then slowly the firing frequency reduces to a constant stretch, which called firing adaptation.

Acknowledgments

We would like to thanks Bruce R. Land from ECE department. He gave us many suggestions on electronic components and helped us optimize the microcontroller design. We also want to thanks Prof Bruce Johnson from Biology department. He provided the guideline of the design, and helped us a lot in testing the project.