資訊工程學系
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預防農作物遭野生動物破壞驅趕系統

壹、摘要及動機

近年來，獼猴受到人類的開發影響，棲息地越來越少，導致沒有多餘的空間去生存，而闖入人類的生活空間，因不當餵食，誘發獼猴的搶食和攻擊性行為，加上農作物被偷吃或破壞，人猴衝突白熱化。

如何不傷害動物、並且將牠們和平驅趕為主要目標

貳、解決方案

Locate the animal which break into farm
Try to aim at the animal (directional)
Using some method to drive the animal away (various)

Portable solution

參、Solution for Monkey

Processing Part

Tasks:
Camera Calibration
Animal Detection
Laser Positioning

Tasks:
Motor Control
IR laser/Ultrasonic Generator Switch

Ultrasonic Speaker is directional device, so we need IR Laser to adjust where the Speaker is pointed to.

CHT(future)

Embedded Computing Device (Jetson Nano)

IR camera

Normal camera

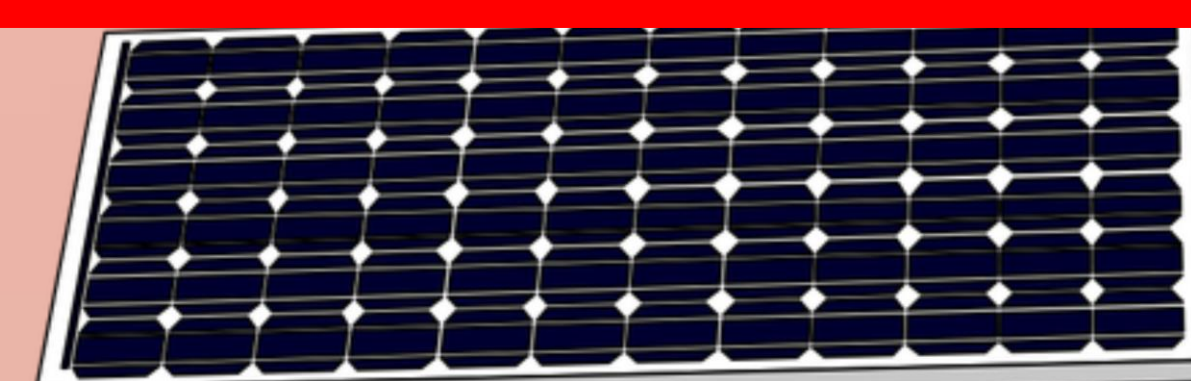Arduino Uno

two Servo Motor

Sensors (future)

UltraSonic Generator
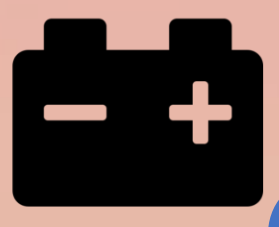
UltraSonic Speaker

IR LASER

Power Part

Solar Panel (max 70W)

Solar Charge controller
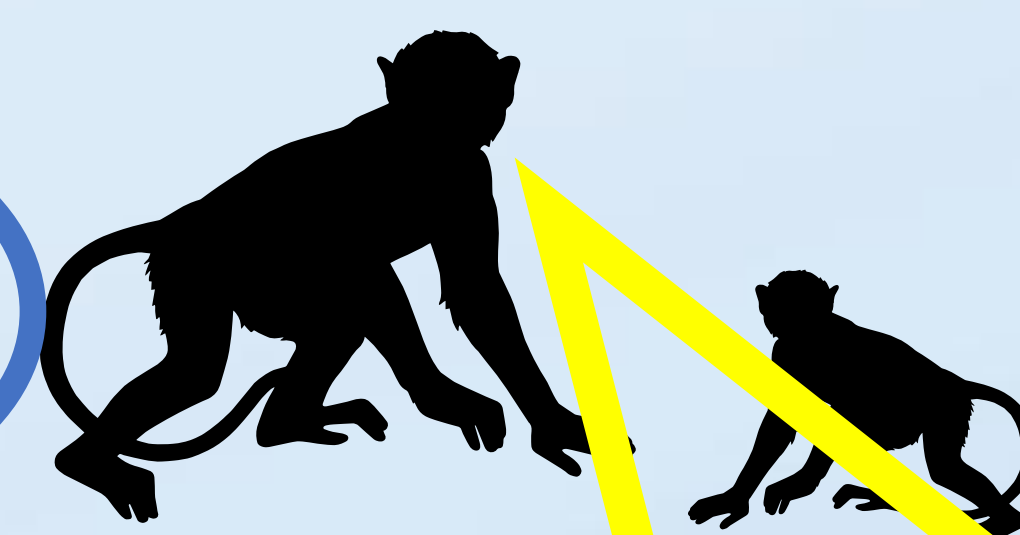
DC≈24v

Power inverter

AC 110v

Battery 24v 16.8Ah

On Portable solution

It's too noisy here, let's stay away from the farm!!

肆、Module details

Camera Calibration : to fix the perspective difference of two camera , which will cause Laser Positioning and Animal Detection coordinates mismatch

Original Image
Up: IR camera
Down: RGB camera

Combine two image

The fence didn't match

Result : after Calibration of RGB camera combined image
RGB camera calibrated

Combine with original IR image

Animal Detection

Detection: Marking the difference of normal farm image with current image
A brick being detected   A people being detected

Tracking: using custom algorithm to judge the marking target is noise or animal movement, if it is animal break into farm , activate KCF tracker for tracking the animal
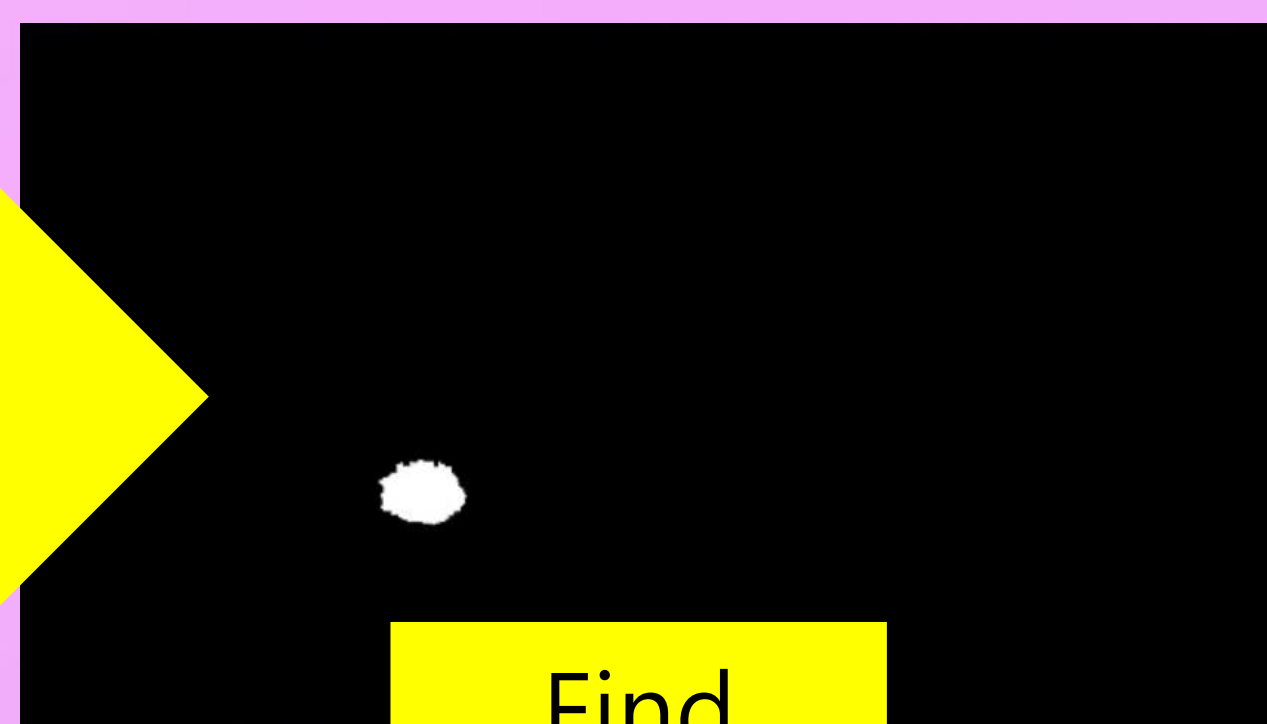
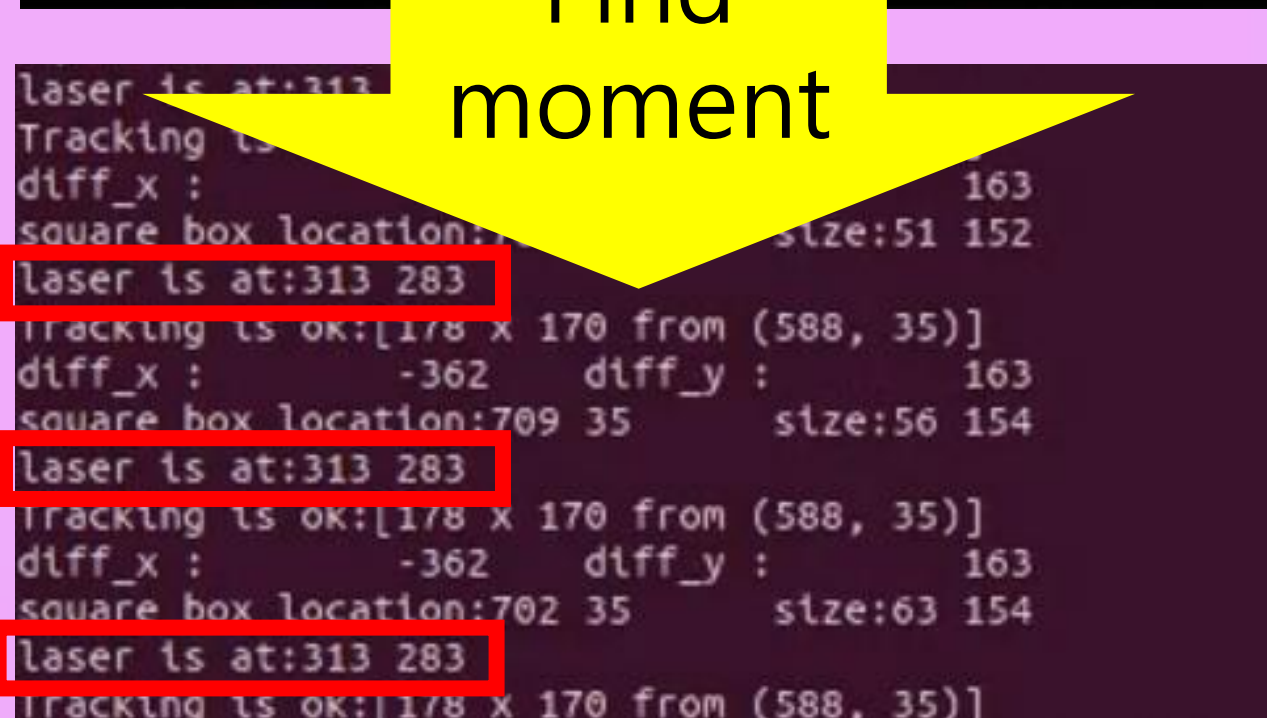Tracking target move

Laser Positioning:
Using luminance and customized intensity filter to produce binary image ,after that find the moment as laser point
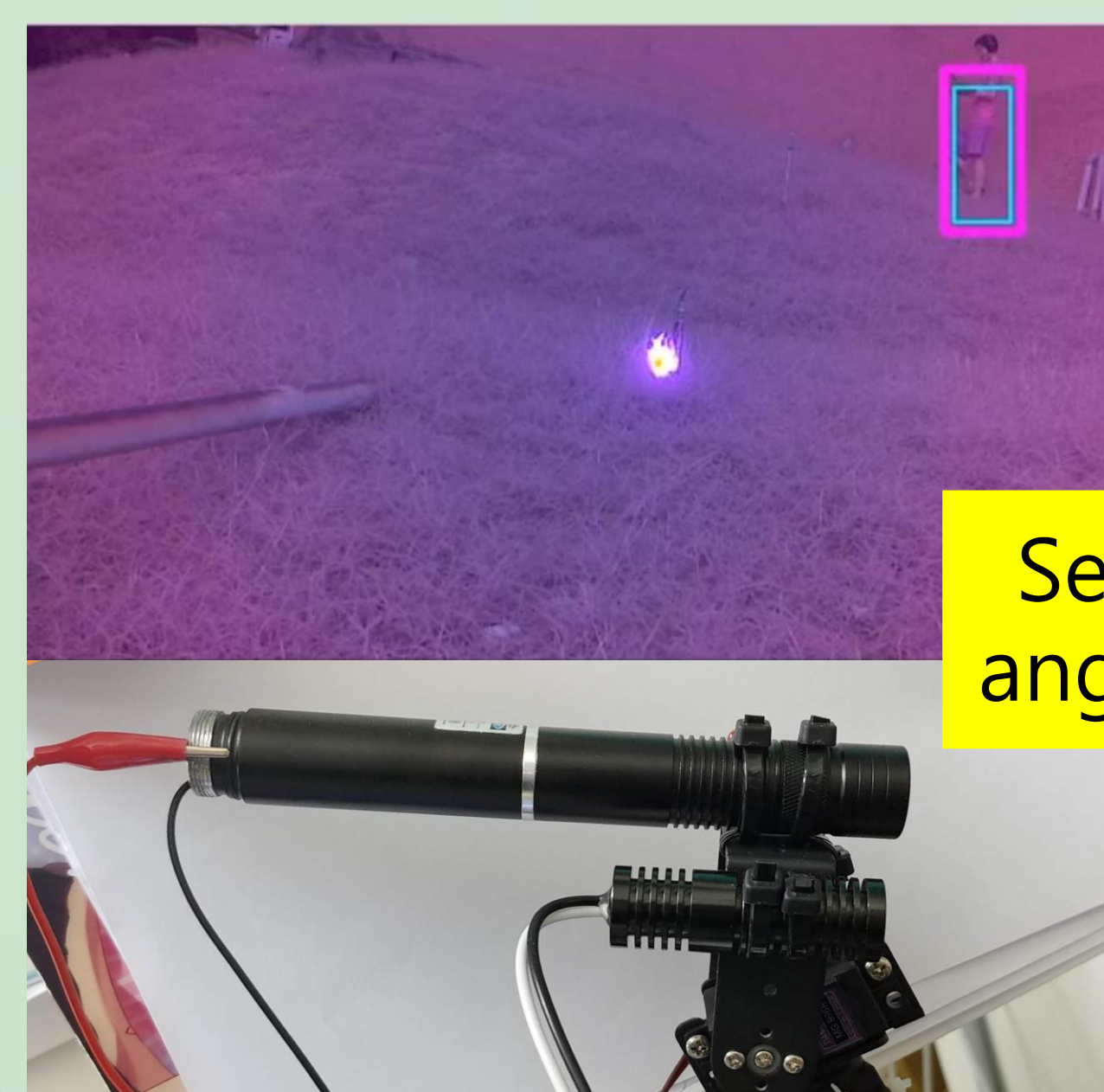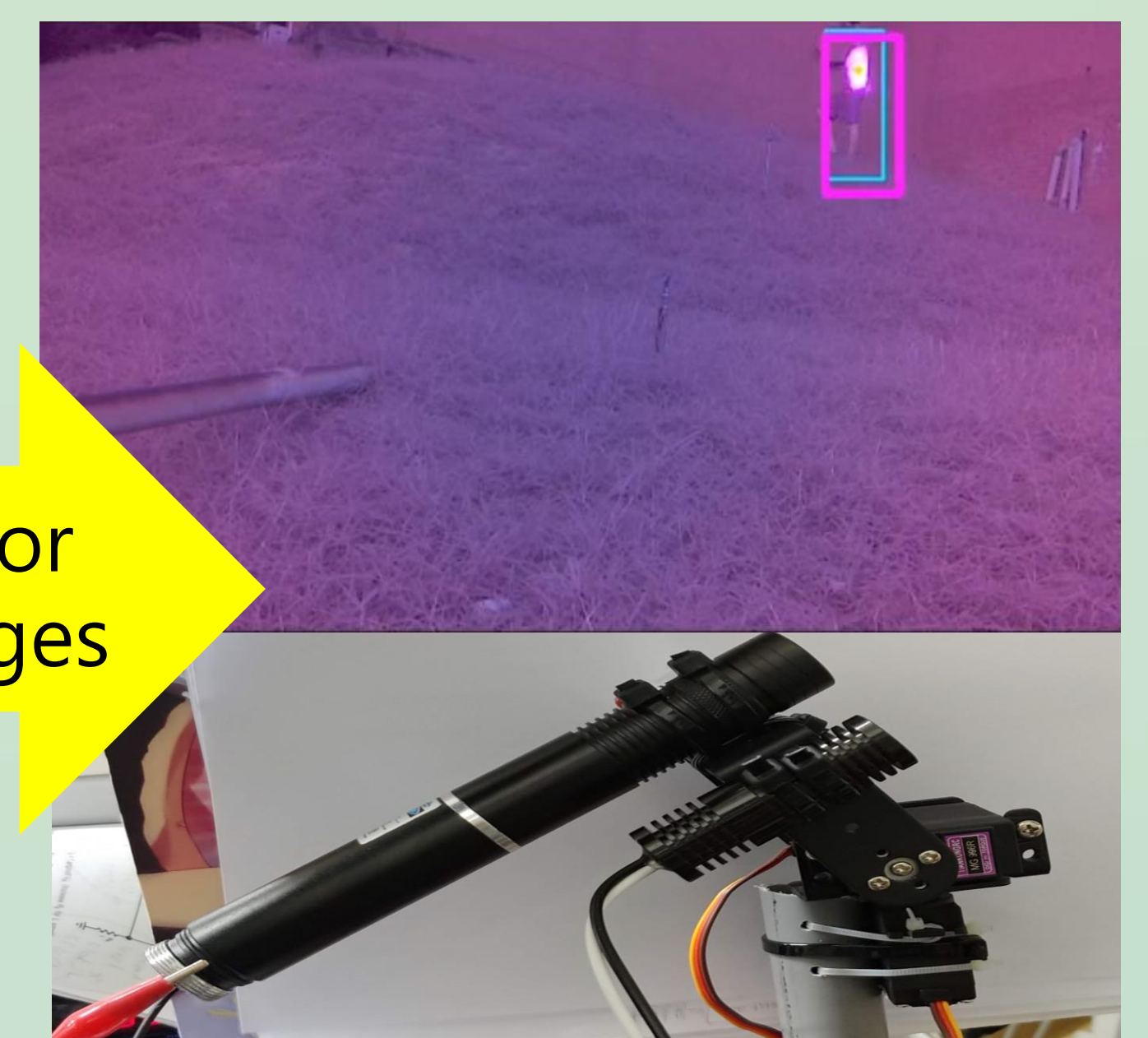
Custom filter

Find moment

Motor Control:
The Embedded computing device (Jetson nano) calculate the difference between laser and tracking target coordinates and assign the angle of servo motor to Arduino which translate angle into PWM signal to drive servo motor
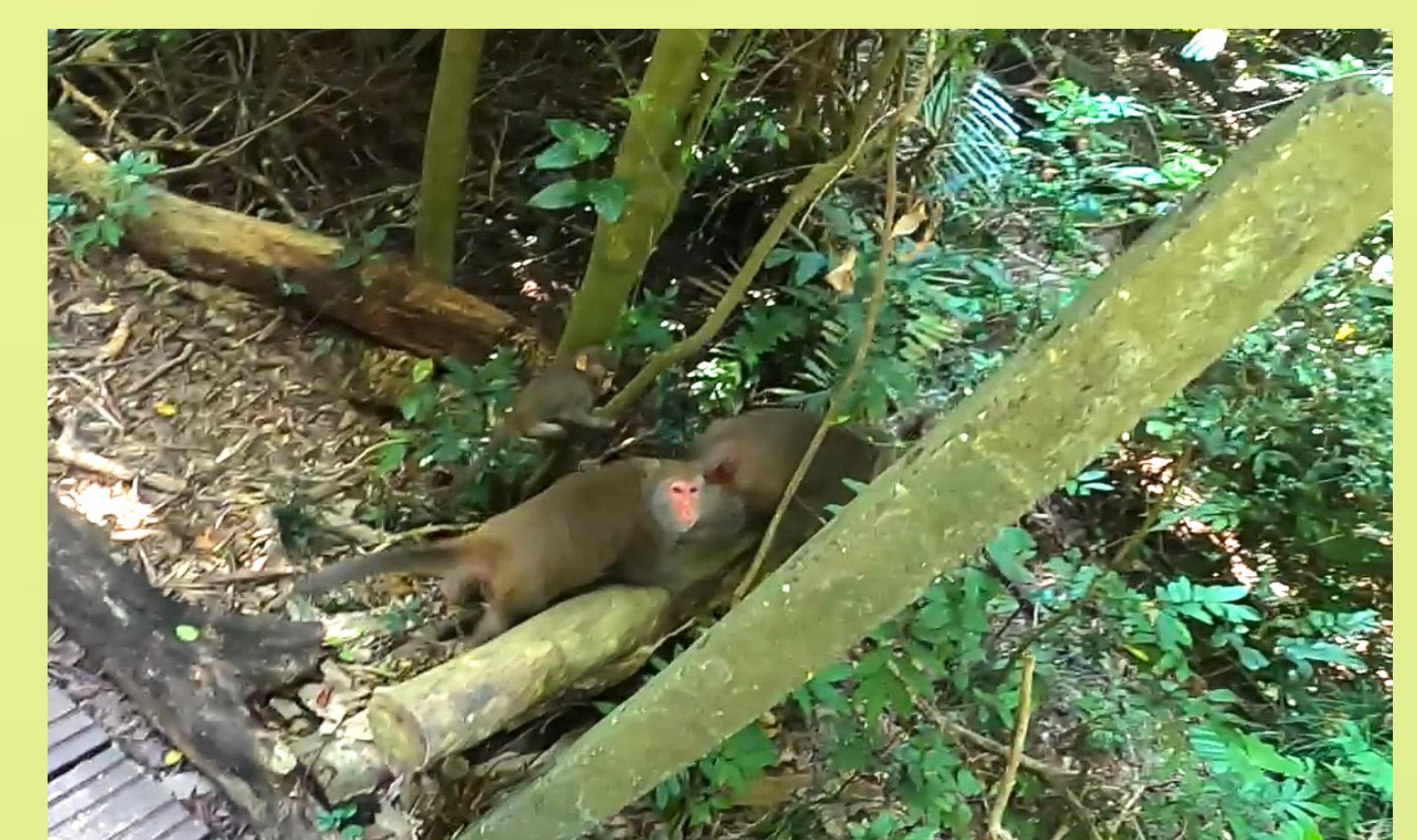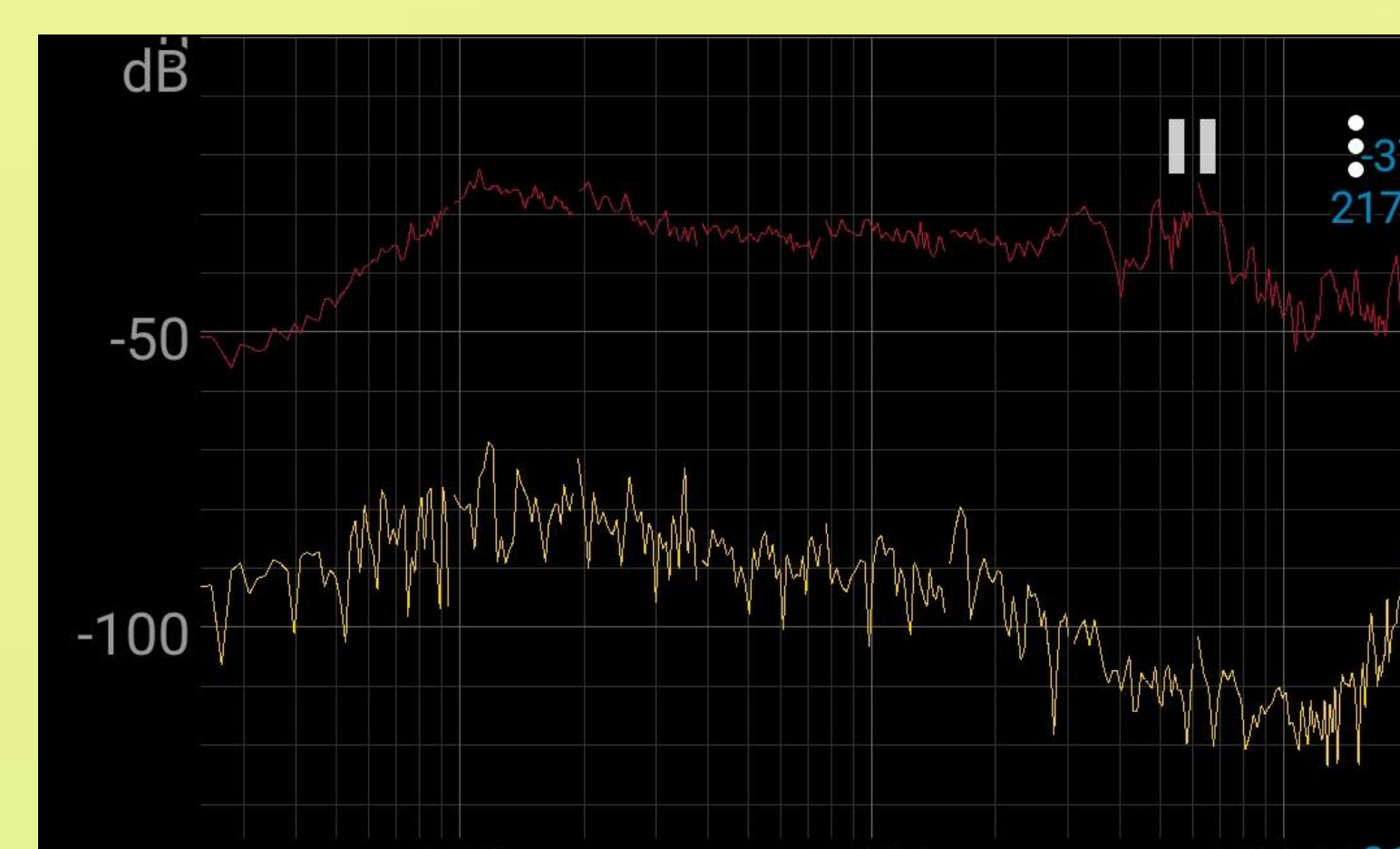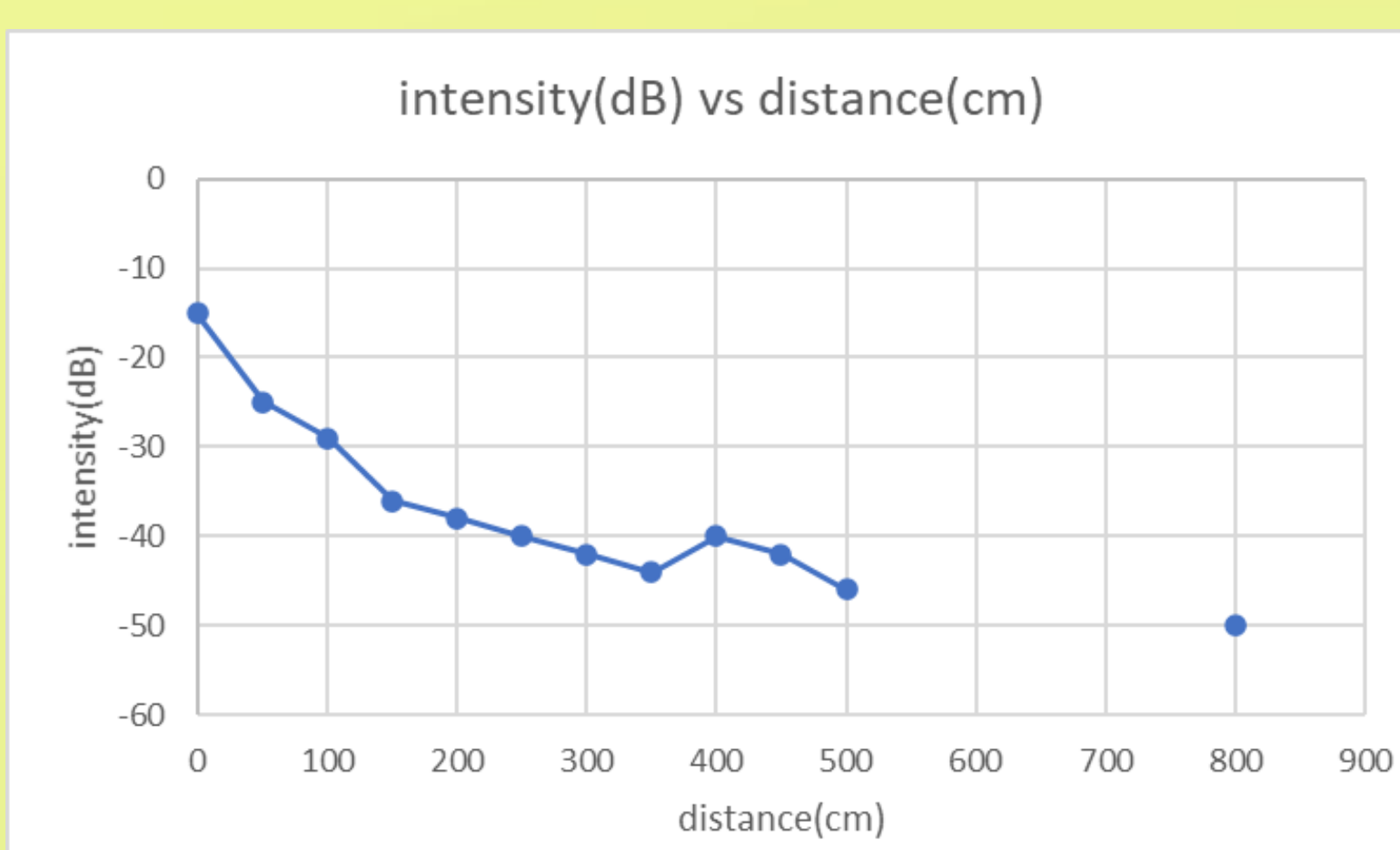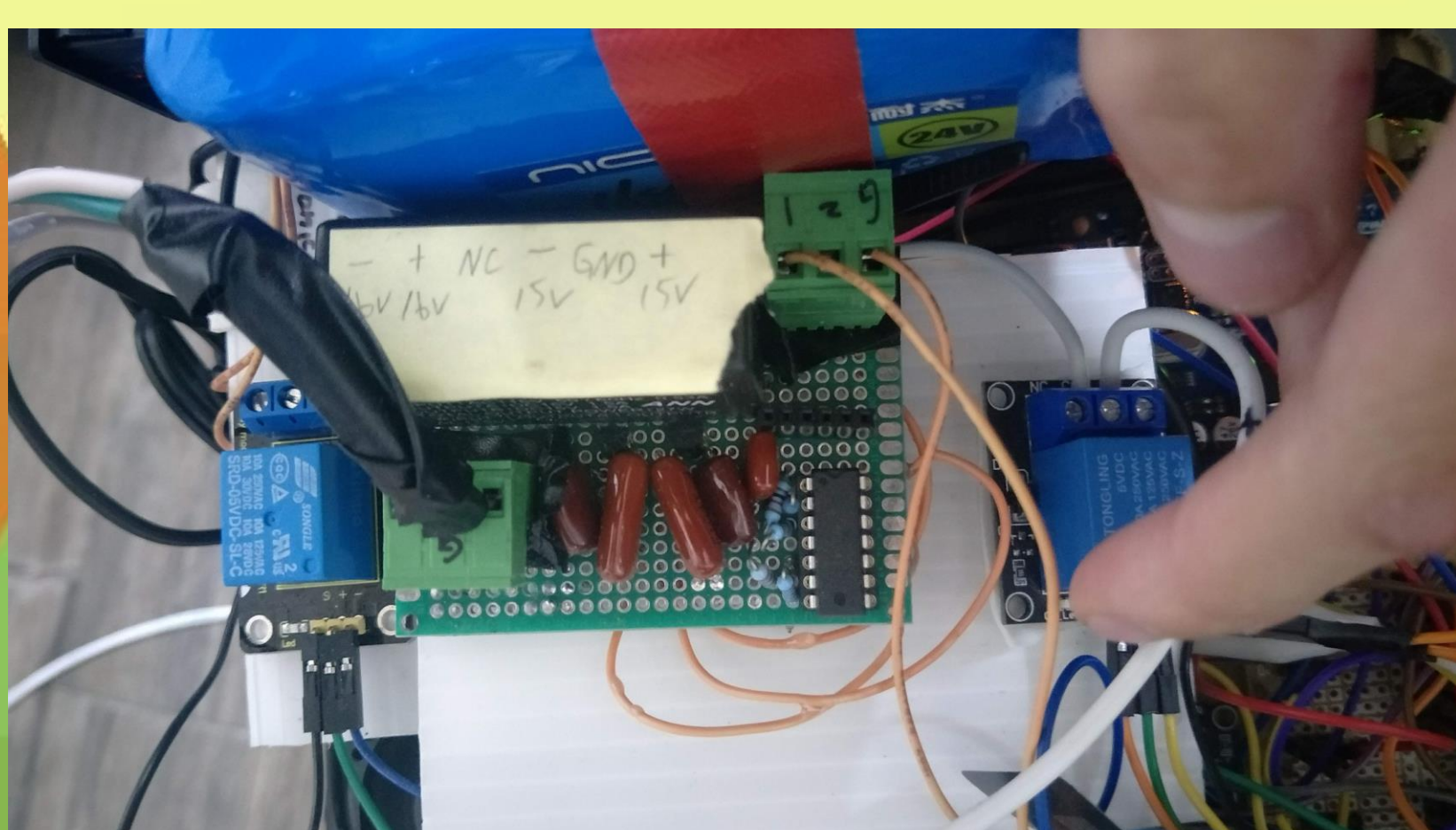
Servo motor angle changes

Drive animal method:
Monkey's hearing can up to 45kHz[1] , An Ultrasonic Sonic with high amplitude might drive them away

Ultrasonic Generator Circuit   Intensity vs distance plot   Cellphone's microphone spectrum   Monkey moves away

intensity(dB) vs distance(cm)

[1] William C. Stebbins, Richard D. Pearson ,et al. "Hearing in the Monkey (Macaca) : Absolute and Differential Sensitivity"