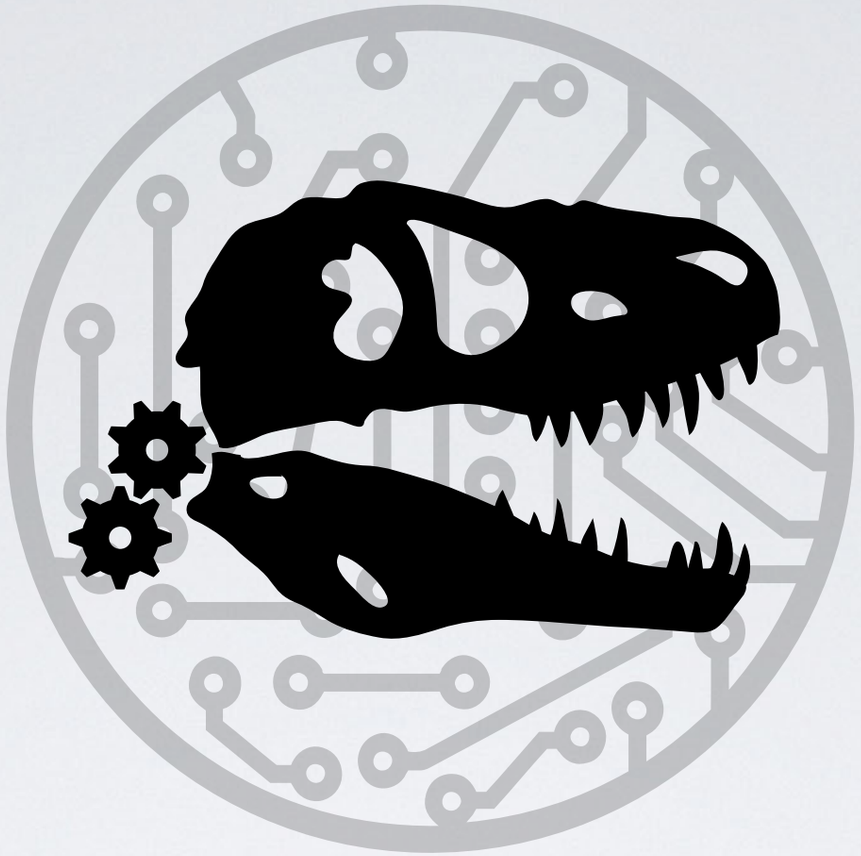


ANIMATRONICS + PROGRAMMING

David Sims

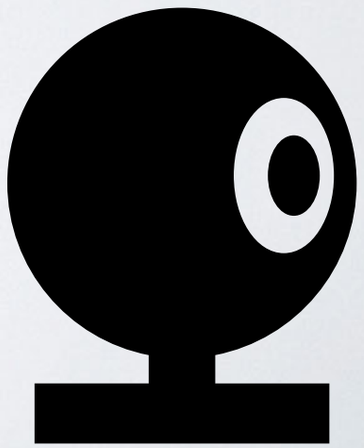
LIT
DEPARTMENT OF ELECTRICAL
AND ELECTRONIC ENGINEERING

ANIMATRONICS

- The technique of making and operating lifelike robots, typically for use in film or other entertainment

- Animatronics = Animate + Electronics

- Animatronic Eye Demo



SERVOMOTORS

- Motors that can be moved to a precise angle
- Angle set by PWM signal
- Controlled by Analog output on Micro-controller

SERVOMOTORS

- Most servos can rotate to any angle between 0° and 180°
- Joints in the human body normally have less than 180° range of motion
- Ideal for Animatronics

WHICH SERVOS?

- Hobby Servos
- Tower SG90 - Plastic Gears
- Tower MG90 - Metal Gears
- SG90s are inexpensive (€2-5) and easy to find
  - IrishElectronics.ie
- MG90s have greater speed and torque

MICRO-CONTROLLERS

- The brains of the operation

- Genie Board E18 *Can control 3 Servos*

- Arduino Uno *Can control 12 Servos*

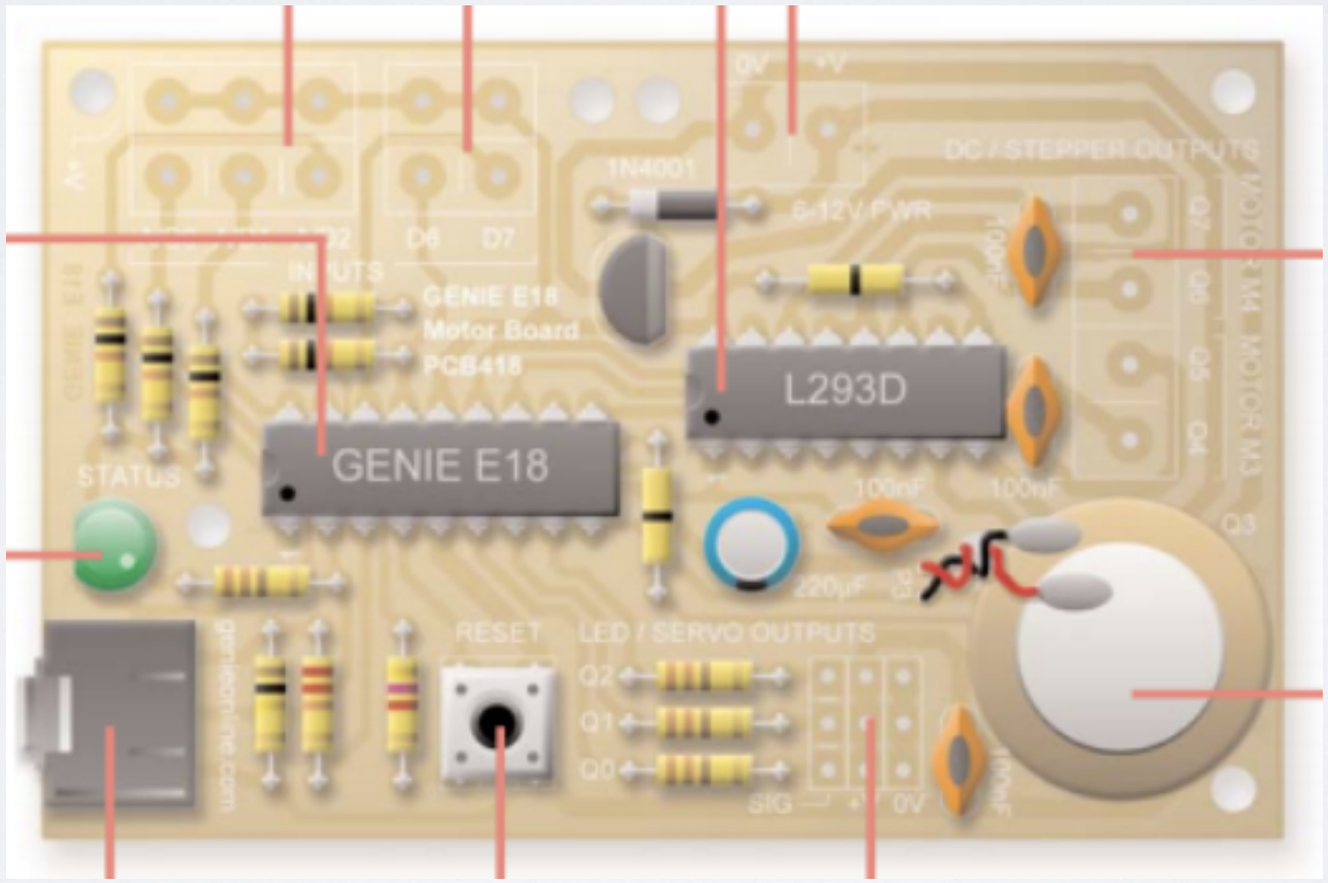
- Arduino Mega *Can control 48 Servos*

MICRO-CONTROLLERS

Genie Board E18 Motor Board

Analog Inputs

Micro-controller

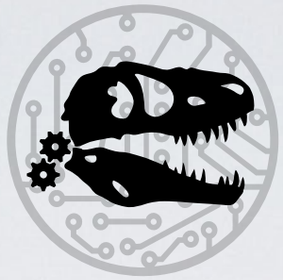


Servo Connections

MICRO-CONTROLLERS

Genie Board E18 Motor Board

Servo Connections



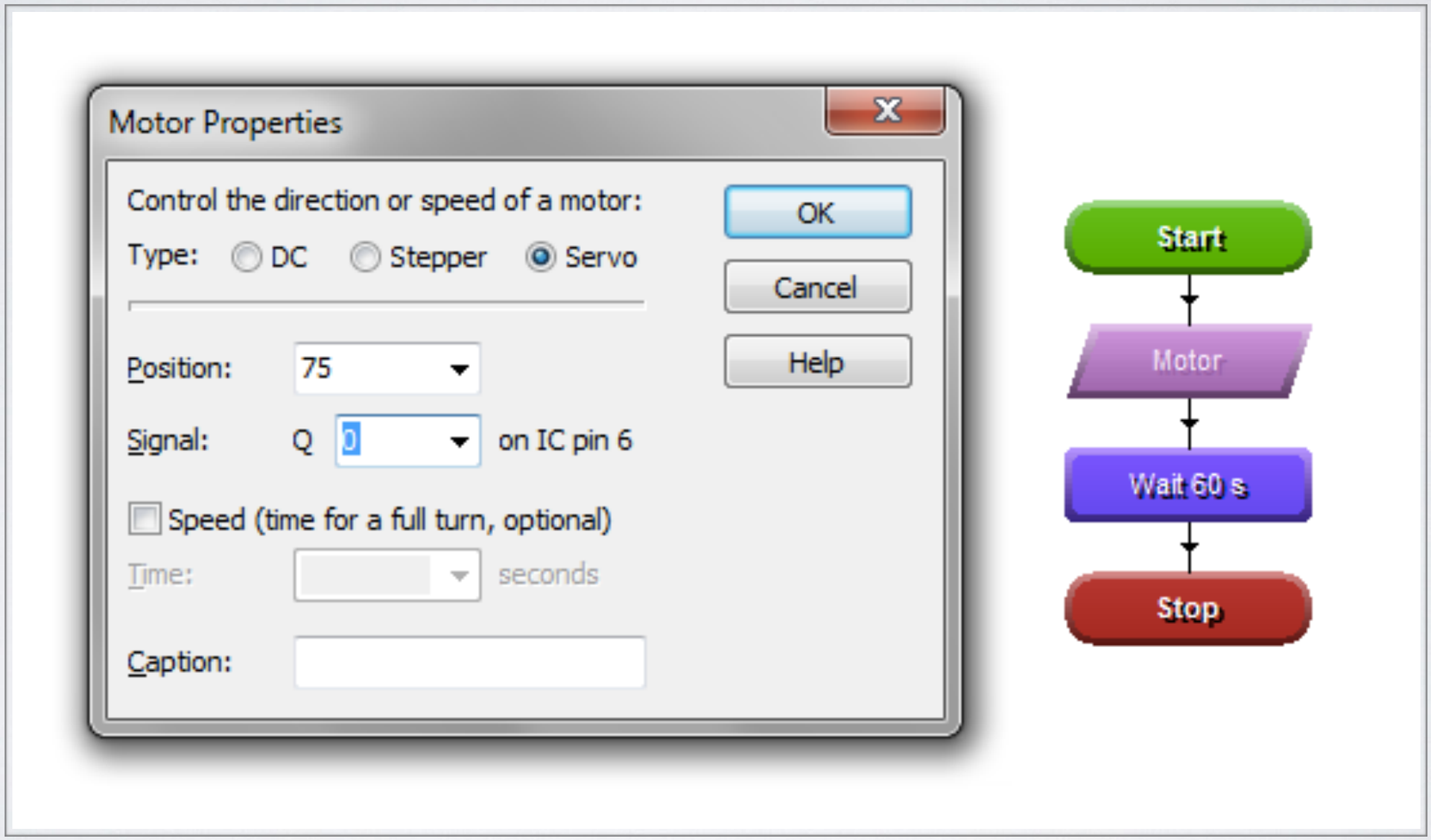
TODAY

- Calibrating Servos
  - How to map Analog values to Angles
- Sweeping a Servo Motor
  - How to move a Servo smoothly/slowly to a desired angle
- Controlling a Servo with Analog Input
  - Move a Servo motor with input from a **L**ight **D**ependent **R**esistor

CALIBRATION

- **Mapping Analog Output to Degrees**
  - Useful if you need to control the precise angle of a Servo
  - Range of motion can vary slightly even between same model of servo
  - Set Servo Output to 75
    - furthermost clockwise

CALIBRATION



CALIBRATION

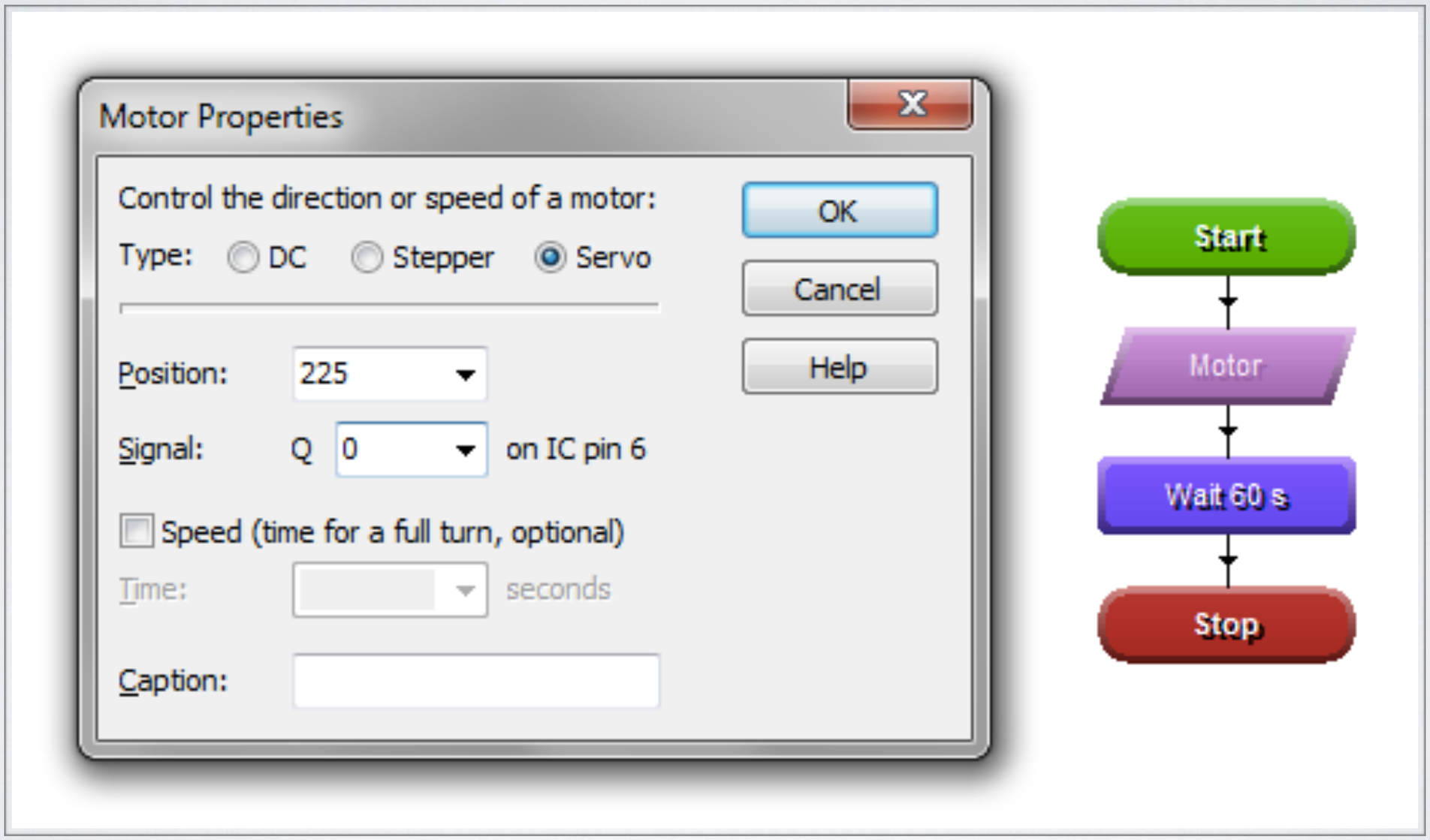
Put arm on Servo lengthways

CALIBRATION

- Mapping Analog Output to Degrees

- Set Servo Output to 225
    - furthermost anti-clockwise

CALIBRATION



CALIBRATION

- Mapping Analog Output to Degrees
  - Measure Angle with protractor
    - Call this Maximum Angle

CALIBRATION

Formula

150*(Angle Wanted/Max Angle) + 75

Example:

You want to move to a 45 degree angle. The max angle of your servo moves to is only 170°.

150 * (45/170) + 75 = 115

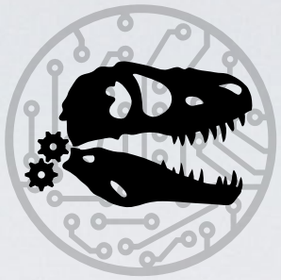
Set output to **115** on Genie Board

SWEEPING

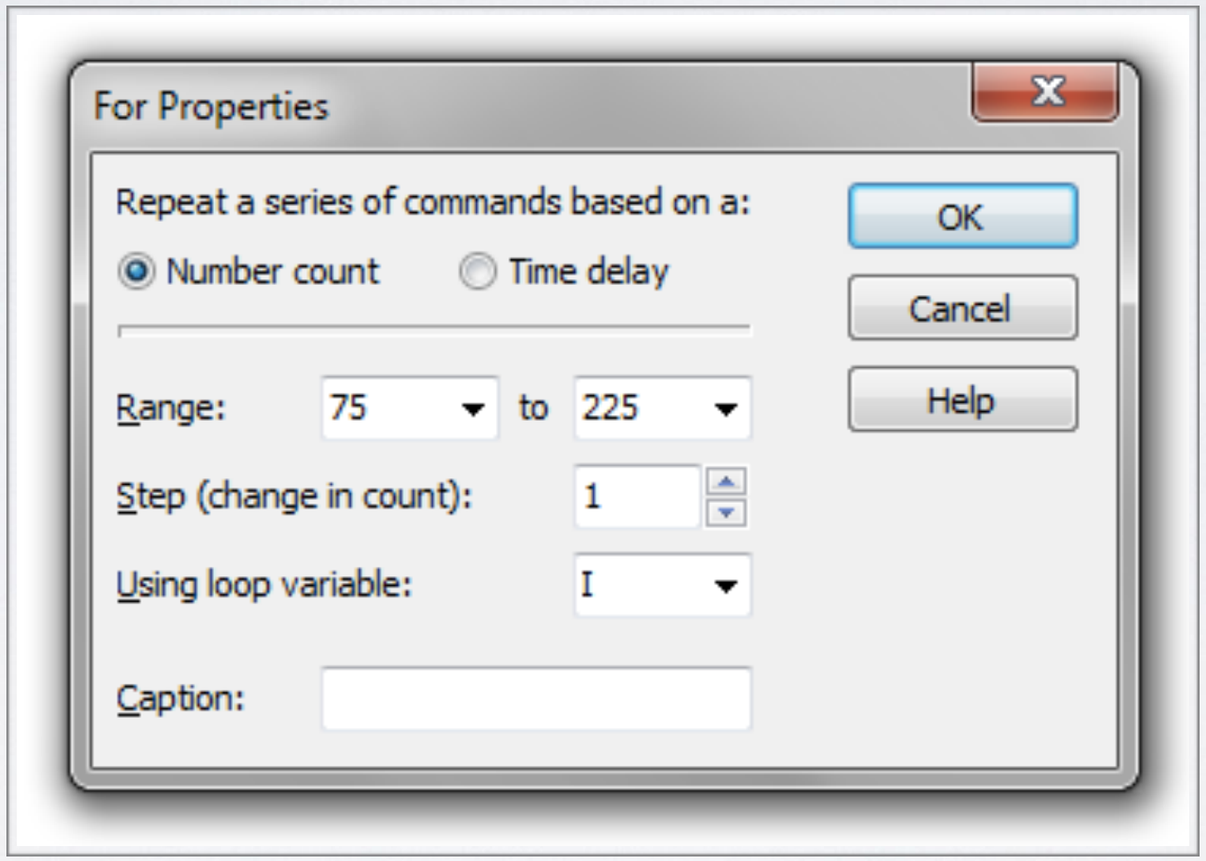
- Move Servo in a controlled manner to a Target Angle
- If you set an angle on a Servo, it will travel there as fast as it can
- Not always desirable when animating with Servos
- Sweeping visits each step on the way to the target angle and delays for a few milliseconds

SWEEPING

- Move Servo in a controlled manner to a Target Angle
  - Use a **for loop**
  - Counts and stores number in variable
  - **Make sure you set the Step correctly!**
    - Positive number if going from low to high
    - Negative number if going from high to low

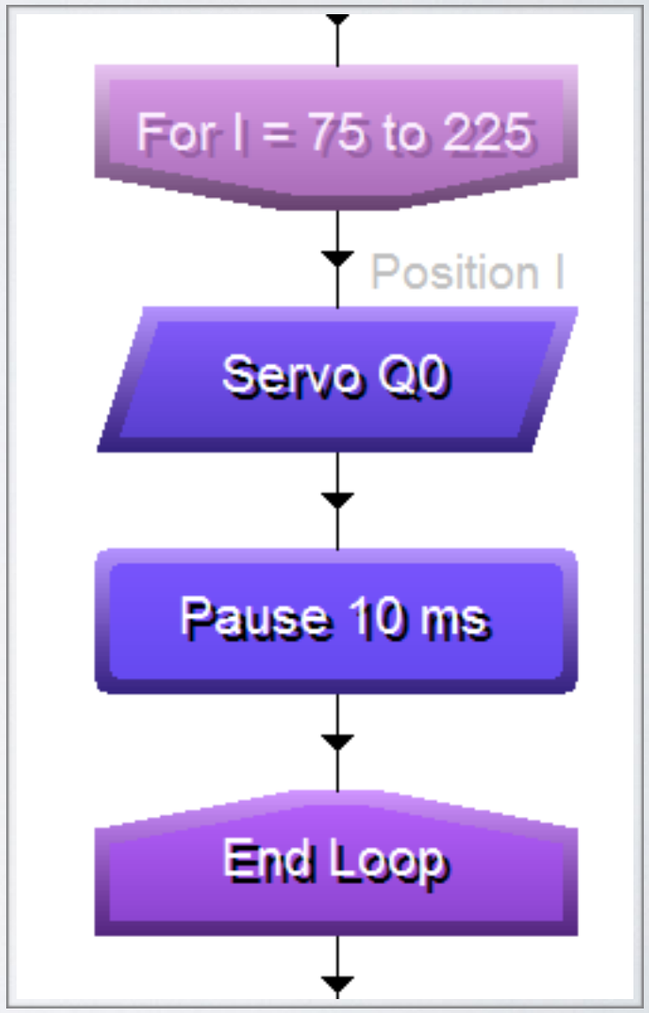


SWEEPING


For Properties
Repeat a series of commands based on a:
Number count
Time delay
Range:
75
to
225
Step (change in count):
1
Using loop variable:
I
Caption:
OK
Cancel
Help

SWEEPING

- Set up **For Loop** using variable i
  From 75 up to 225
- Set Servo to position i
- Pause for 10 milliseconds
- Repeat Loop if i still not 225



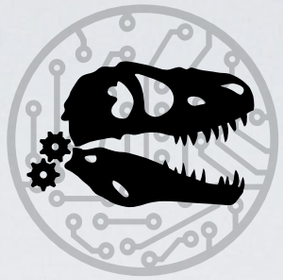
SWEEPING

- Set the *to* value of the for loop range to the analog value of your desired angle

- Increase the duration of the pause to slow down the sweep

- Decrease the duration of the pause of speed up the sweep

- Modify the value of Step to move Servo in larger steps



SWEEPING

- What happens when you remove the pause?

- ***Remember*** to check the **pause** if your sweep doesn't work

- ***Remember*** to check the **Step** in your if statement if your sweep doesn't work

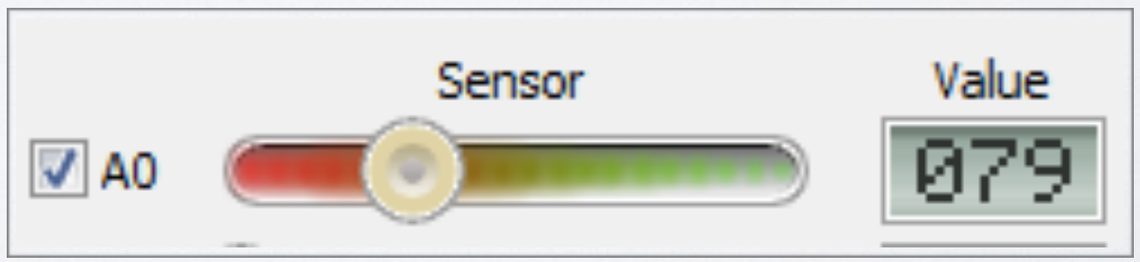
SAMPLE EYE ANIMATION LOOP

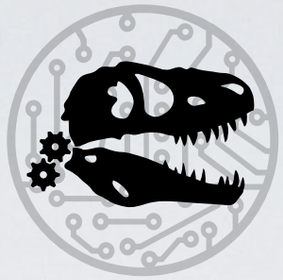
ANALOG INPUT

- **Controlling Servo with Analog Input**
  - Genie Board E18 has 3 Analog Inputs
  - Analog inputs are ranged between 0 and 255
  - Servos are controlled with outputs between 75 and 225
  - 105 of the 255 analog input values will have no effect if we simply output the value that is input
  - We can map 0-255 to 75-225 in code

ANALOG INPUT

- **Controlling Servo with Analog Input**
  - Connect **LDR** (or other resistive sensor) between A/D0 and V+ on the Genie Board E18
  - You can use the Sensor calibrator in the Genie Software to see what values are being received by the micro-controller
  - Shine a torch to see the range of values the LDR is capable of generating.

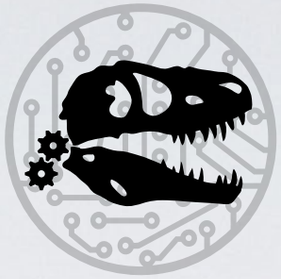




ANALOG INPUT

- **Controlling Servo with Analog Input**
  - Mapping Input Range to Servo Output (150 values from 75 to 225)
  - LDR reads between 0(dark) and 255(full brightness)
  - To scale:
    - 150/255 = 0.58
    - Multiply input by 0.58
    - Add 75


Start
0 = 0
While
In A, A0
Scale A x 0.58
A = A + 75
Position A
Servo Q1
Pause 10 ms
End Loop
Stop



QUESTIONS?

Code on USB given to Teachers