

Project Work

The Egg Drop Experiment

Challenge

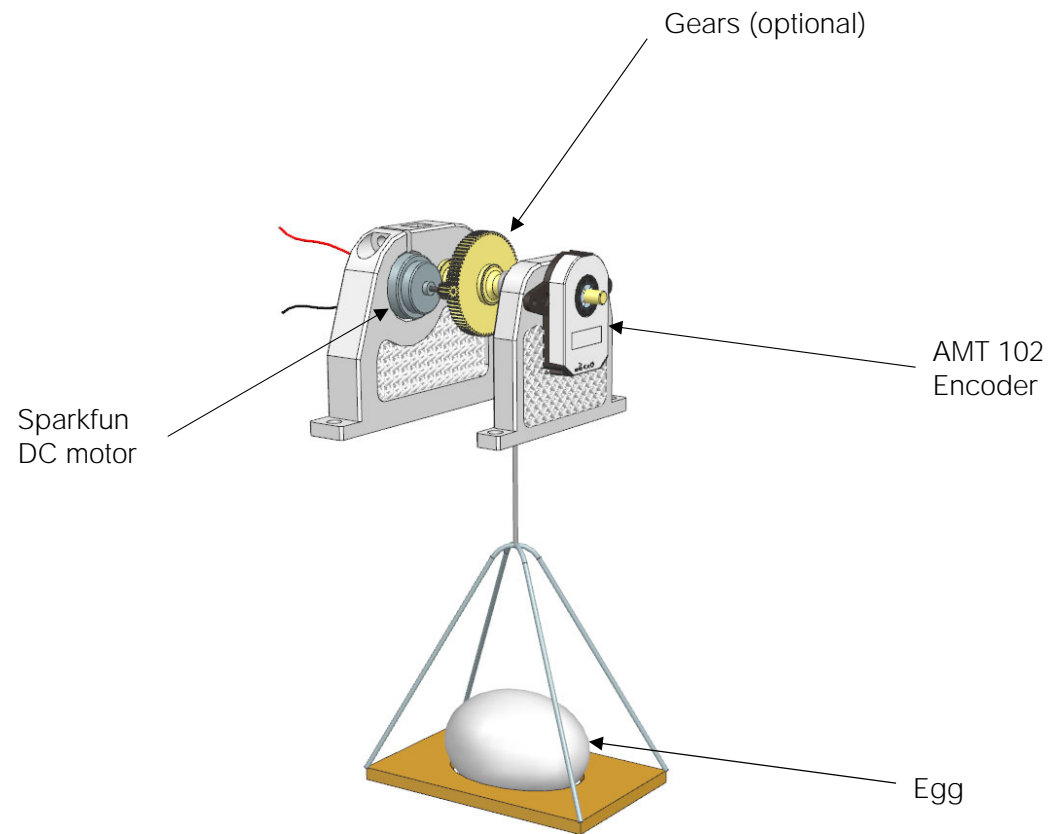
Lower an egg from 20cm height to the ground without breaking the egg. Fastest time wins.

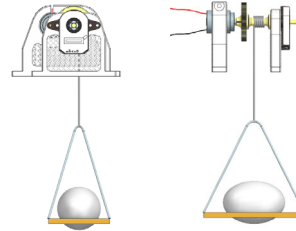
Competition Rules

Use DC motor from Sparkfun kit.
You can break as many eggs as you like.
You have three attempts in the competition.



Setup



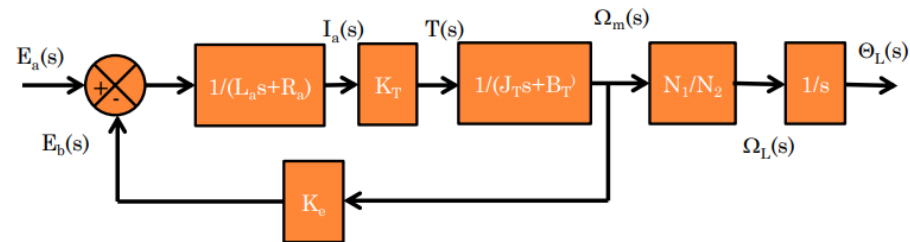


Project Description:
System Identification of
DC Motor

The task is to estimate system parameters for a DC motor using an Arduino Uno microcontroller. The project consists of the following steps:

- (1) Set up the circuit with components from provided schematic.
- (2) Write Arduino program code for controlling the DC motor with Pololu TB67H420FTG motor driver, and record shaft angle using rotary AMT 102V encoder.
- (3) Perform experiments for generating input (voltage) and outputs (shaft angle). Save in- and outputs to file that can later be imported to Matlab (we should provide an independent validation dataset).
- (4) Import data in Matlab, and perform system identification.
- (5) Tune PID-controller with identified system, and try it out on the DC-motor.
- (6) Present findings in final presentation, and compete in egg drop challenge. **Date: 19.09.23!**

Project Description:
System Identification of
DC Motor



θ_L is motor position.
 E_a is armature voltage.
 K_T is motor torque constant.
 N_1 and N_2 is gear ratio.
 J_m is motor inertia.
 L_a is armature inductance.
 B_m is motor friction.
 R_a is armature resistance.
 K_E is back emf constant.

$$\frac{\theta_L(s)}{E_a(s)} = \frac{K_T \left[\frac{N_1}{N_2} \right]}{J_m L_a s^3 + (B_m L_a + J_m R_a) s^2 + (B_m R_a + K_E K_T) s}$$

Full derivation of model:

<https://www.engr.siu.edu/staff/spezia/Web438A/Lecture%20Notes/lesson14et438a.pdf>

(Spezia, Southern Illinois University Carbondale, visited 30.08.2021)

Hardware

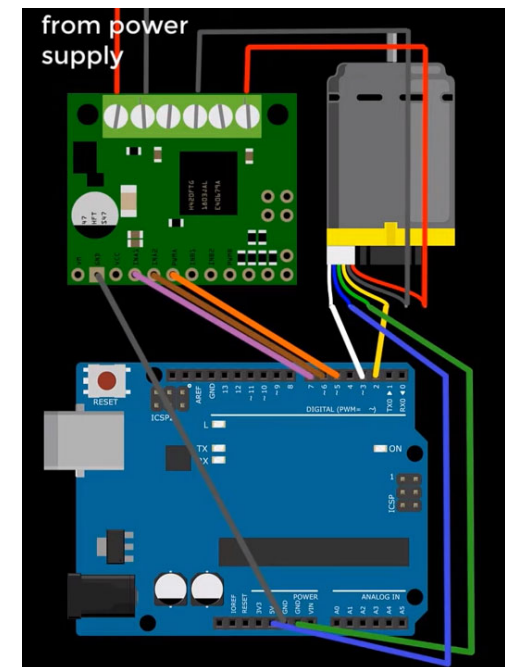
Arduino Uno microcontroller (or similar)
Pololu TB67H420FTG motor driver (or build your own circuit)
Sparkfun DC motor
AMT 102V rotary encoder
External Power supply
Mechanical parts
Egg

Resources

Circuit and coding tutorial:
<https://www.youtube.com/watch?v=dTGITLnYAY0>

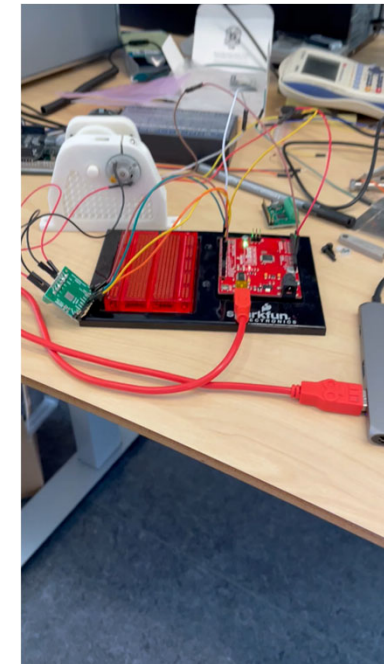
Encoder mounting instructions:
<https://www.cuidevices.com/amt-mounting>

Github repo (Matlab files, CAD, STL, etc.):
<https://github.com/oystebje/EGGDROP>



Data collection

Input PWM signal	Output shaft angle [deg]	Elapsed time [ms]
1427	-73	9058
997	-73	9073
1456	-73	9090
1534	-73	9106
1060	-73	9123
2854	-73	9140
933	-73	9155
185	-73	9170
1466	-73	9188
1451	-73	9204
395	-73	9220
1461	-74	9236
1432	-75	9253
1490	-75	9270
1119	-75	9286
1598	-76	9303
1392	-77	9320
1378	-78	9336
1441	-79	9353
1422	-79	9369
899	-80	9385
1568	-80	9402
1402	-80	9418
557	-80	9434
1451	-80	9451
1539	-80	9467
244	-80	9483
1471	-80	9499
1598	-80	9517
1471	-80	9533
1016	-80	9549
2619	-80	9566
2653	-80	9583
1388	-80	9600
1329	-80	9616
1388	-80	9632
840	-80	9649
1520	-80	9665
1466	-80	9681
395	-80	9697
1495	-80	9714
1480	-80	9731
1490	-80	9747



Project Description:
System Identification of
DC Motor

You must set up experiments that replicate
the egg drop competition!

Remember get good training AND
validation data.

