WORCESTER POLYTECHNIC INSTITUTE

ROBOTICS ENGINEERING PROGRAM

RBE2002 - Final Project

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Abstract

A whiteboard erasing robot was created. Awesome. Spectacular. LaTeXforever.

Contents

1 Introduction

The goal of the final project is to incorporate sensing, filtering, and control systems into a whiteboard erasing robot. The robot is required to he robot, which your team must design and build, must hang from the support cable using the supplied hook. The robot must incorporate a whiteboard eraser, which will be provided to you in the KOP. You may modify the eraser (within reason) to meet your design needs. The eraser must have a complicated motion to it as it erases. It will not be acceptable to simply mount the eraser on the end of a motor shaft and spin it. The robot should be able to use the eraser to clean the whiteboard. The robot will be semiautonomous. It must be capable of performing teleoperated subtasks and autonomous subtasks. You will have a VEX radio transmitter and receiver in your KOP to provide teleoperator control of the Eraserbot. The sequence of the operations will be as follows: The robot should hang on the whiteboard in a given position and wait for a starting command. You will most likely want to use manual control of the shuttle/winch motors via the Vex radio to control this operation, but it may optionally be performed automatically if you wish (see below). The erasing subtask will be autonomous. The robot will need to deploy the eraser to make contact with the whiteboard. It is responsible for erasing the whiteboard to within 1 of the edge of the window frame. When it is done erasing an area it should retract the eraser so it can (optionally) move to another area to be erased. Note well: The robot will need to be in contact with the whiteboard at additional points/areas beyond the eraser surface in order to successfully erase the board. The teleoperator can restart the erasing subtask. The teleoperator can stop the erasing subtask at any time.

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2 Method

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Table 1: Coefficient of Friction of the Eraser

Fall angle (°)	Additional Weight (g)	Location	μ_k
25	0	1	.466
25	0	1	.466
20	250	1	.364
20	250	1	.364
21	250	2	.384
21	250	2	.384
25	0	2	.466
25	0	2	.466

3 Analysis

3.1 Eraser Friction

The central goal of the final project is to successfully execute force sensing. Calculating the coefficient of friction between the eraser and the white board was a simple metric to discover. A tilt jig was setup to find this value. ¡TODO: image in appendix¿ The coefficient of friction, μ_k, is equal to $\tan(\theta)$. The angle θ is the angle at which the eraser begins to fall. The results are seen below in Table 1.

3.2 Erasing Normal Force

In order to determine the minumum normal force required to erase, another test was performed. Weight was added to the top of the eraser. It was then pushed along the surface to qualitatively determine the effectiveness in erasing. ¡TODO:Table in appendix¿. It was found a total mass of 550 grams to 600 grams was a desirable minimum normal force for erasing. This is about 5.4 Newtons of force.

3.3 Spring Analysis

3.4 Erasing Motion

4 Results

4.1 Force Sensor

4.2 Swing Arm

4.3 Erasing Motion

4.4 Software

5 Discussion

5.1 RLC Circuits

6 Conclusion

In conclusion, this experiment xxx xxxxx xxxxx xxx xxxx xxxx xxxxx xxxxx xxxx xxxxx xxxx xxxxxxxxx xxx xxxxx xxxxx xxx xxxx xxxx xxxxx xxxxx xxxx xxxxx xxxx xxxxxxxxx xxx xxxxx xxxxx xxx xxxx xxxx xxxxx xxxxx xxxx xxxxx xxxx xxxxxxxxx xxx xxxxx xxxxx xxx xxxx xxxx xxxxx xxxxx xxxx xxxxx xxxx xxxxxxxxx

7 Comments

References

A Raw data

Table 2: Resistance and Temperature of the Filament

Fall angle (10 °C), Additional Weight, K	$1/T$, K^{-1}	$\ln P$	
151.00±3.92	828.35±23.46	1.2072×10^{-3}	-13.29
157.12±3.71	856.88±22.25	1.1671×10^{-3}	-12.64
162.53±3.49	881.99±21.02	1.1338×10^{-3}	-12.33
166.67±3.33	901.14±20.13	1.1097×10^{-3}	-11.90
171.84±3.17	924.98±19.25	1.0811×10^{-3}	-11.25
176.84±3.04	947.96±18.53	1.0549×10^{-3}	-10.77
181.46±2.90	969.13±15.49	1.0319×10^{-3}	-10.20
186.49±2.79	992.09±17.18	1.0080×10^{-3}	-9.66
190.91±2.69	1012.21±16.65	9.8794×10^{-4}	-9.13
195.48±2.59	1032.95±16.45	9.6811×10^{-4}	-8.60
199.93±2.50	1053.08±15.65	9.4960×10^{-4}	-8.10
204.47±2.41	1073.56±15.19	9.3148×10^{-4}	-7.63
208.62±2.34	1092.22±14.83	9.1556×10^{-4}	-7.16

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