Hoist Stabilization Design Method

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Abstract. The goal of this project is to design and model a mechanical stabilization system for low-mass sling loads in medical evacuation (MEDEVAC) helicopter rescues. The additional goal for this project is to create a software simulation of the system. The current project's final purpose is to test and characterize the model system. There are three target specifications for this project. The first specification outlines the two vertical hoist speeds of the lift at 0.381 m/s and 0.501 m/s. The second specification outlines the stabilization angle from a maximum angle of 15 degrees to less than 5 degrees. Finally, the third specification outlines the two initial cable lengths of 7.9248 meters and 32.3 meters.

Introduction

In a medical evacuation (MEDEVAC) helicopter rescues, the goal of any medical evacuation is to get the patient safely into the helicopter and then to a medical facility as quickly as possible [1]. This project aims to design and model a mechanical stabilization system for low-mass sling loads in medical evacuation (MEDEVAC) helicopter rescues [1]-[5]. The optimal way to achieve this is to have the patient hoisted up into the helicopter while it is moving [4]. This, however, is difficult as the patient is being swung in an oscillating pattern, similar to a pendulum, and would need to be stabilized to not cause further injury or harm. The idea proposed to solve this is to have the sling be hoisted and lowered at various velocities to compensate for the change in angular velocity [5]. This would be achieved by having a device at the helicopter that would measure the rate and angle of oscillation and, using that information, adjust the velocity at which the sling is being hoisted. By having a device that can measure the current angle of the sling as well as control the velocity of hoisting the patient, the swinging motion can be reduced or eliminated. Our model assumes the helicopter is in a steady hover.

Bill of Materials for Design Alternative 1: Encoder and Gyroscope	
Item	**Cost ($)**
Encoder and Motor Bundle (None) Bemonoc	$15.99
Buttons (JF-0020) QTEATAK	$5.99
Switch (MTS-101-F1) DAIERTEK	$7.99
Motor Driver (L298N) HiLetgo	$11.49
Arduino Mega (A000067) Arduino	$38.93
Boost-Buck Convertor (LM2596) Atnsinc	$9.29
DC Adapter (12V2A-03081947) DTECH	$11.88
OLED Module (U602602) UCTRONICS	$6.99
RUNCL Braided Fishing Line	$17.99
BWT901 High-Precision Gyroscope	$45.99
Current Estimated Total	**$172.53**

Figure 1: Build of materials.

Results and Discussion

A requirements analysis of the project specifications was performed, and the target specifications were determined. First, a length of 46 feet was determined to be the maximum length a lift would be performed. Second, the maximum weight of the sling was identified at 600 pounds. The lift system has two possible speed settings: slow and fast [4]. The angle takes on a maximum value of 15 degrees with a goal of 5 degrees. The design choice (Fig. 1) was determined to be using the encoder as well as a gyroscope as this allowed for more precise data to be generated and sent to the controller. Building a custom controller was found to be more efficient for the team's purposes as it allows for more customization.

References

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