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Elevator systems (Chain, Belts, Rope, Rack and Pinion)

Team 3176 Robotics - 2018

Elevator Lifting System Comparison

Summary

Elevators can be powered in multiple ways, each having their advantages and disadvantages, depending on the situations they are tested under. This paper is meant to compare systems so others can quickly decide what kind of elevator to use if they need one for a future game.

Chain

Chain powered elevators are able to slip less because they are held by a sprocket, therefore binding them in place. They are also very energy efficient, as you need much less chain to get the same amount of power as lots of belt. Chains do however, need a lot more maintenance in order to stay running smoothly. They also are hard to tension right, and having the wrong tension could make the elevator too loose or too tight, causing it to move too much or not move at all.



Many teams used elevators in the 2011 LOGO Motion game. Team 2729 used a chain powered elevator with *Crimson Claw*.

Belts

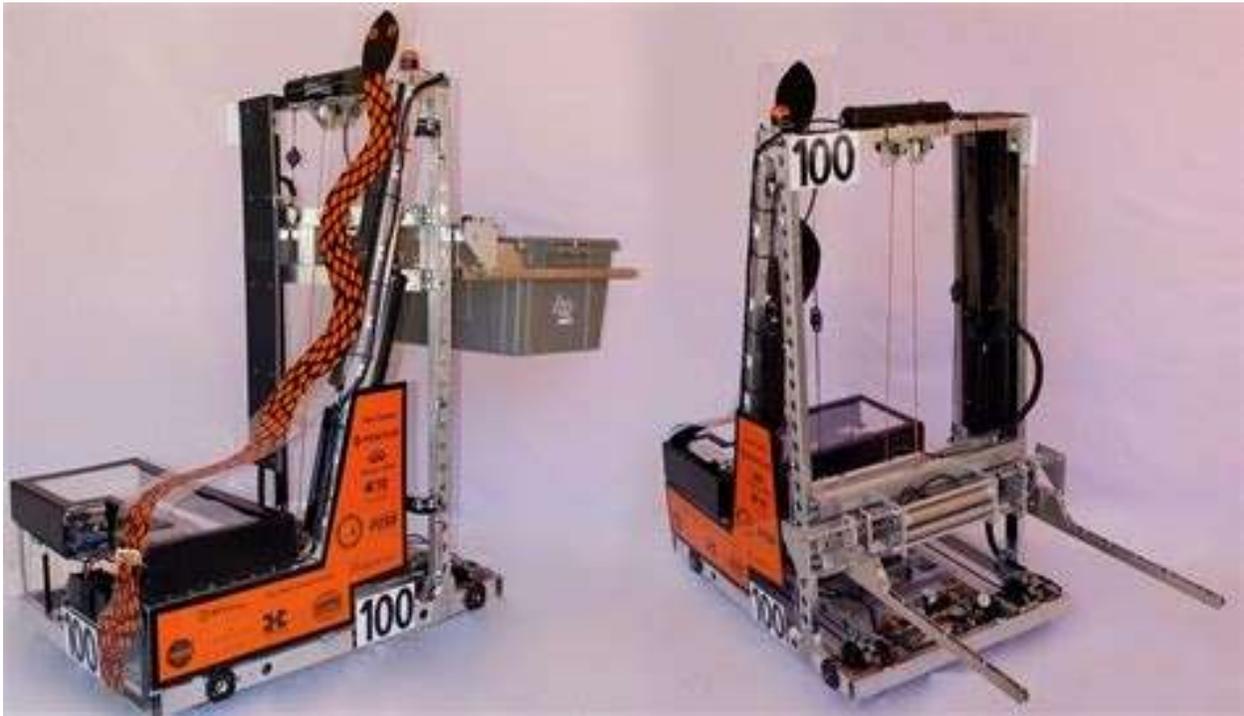
A belt driven elevator system has the advantage of being already tensioned, and therefore much easier to apply. A belt elevator also needs very little maintenance and will run smoothly on its own. Everything does come at a cost though, and the little maintenance means it cannot hold up weight as well as an equal amount of chain could. Belts also have a tendency to slip, but this issue can be solved by using a timing belt.



Team 254 used a belt powered system in 2011 on *Slipstream*.

Rope

An advantage to using rope is that we can multiply the effect of force by using a pulley to spool the rope around. We will not have to strain a motor to generate enough force to lift many pounds of weight, as adding a system of pulleys would reduce the amount of force needed to lift objects. A disadvantage to this is rope strength. We will be reducing motor strain, but the rope may hold a possible hundreds of pounds of force. This is something that a chain could easily do, but something flexible like rope could struggle with greatly. Therefore, we will need to make sure the rope is sturdy and strong, such as Paracord.



Team 100 used a rope pulley system in 2015 with *Slidewinder*.

Rack and Pinion

Similar to rope, the rack and pinion can reduce the energy required to vertically lift an object. In order to do this the pinion must be small, to take advantage of gear ratios and reduce the torque a motor has to create. It is also cheap and compact. A downside to the rack and pinion is its inefficiency. It uses extra energy to overcome friction. It also requires lubricant to function smoothly. It was difficult to find a picture because Rack and pinion is rarely used because it is a heavy system that is generally not the fastest

Results

Overall, for the 2018 game we found rope most useful. This is because it can be very flexible, unlike other systems, and is able to maintain lots of weight if used correctly. It reduces energy needed for vertical lift and functions smoothly without lubricant. It also costs very little and weighs almost nothing. This system beats out others because it is light, cheap, compact, efficient, and low-maintenance. Its main disadvantage is it does not carry large amounts of weight well. This does not affect us in 2018 however, as we are lifting boxes that are only 3.5 pounds. Overall, I think rope is the best system to use for FRC® Games because it can be cheap, light, compact, and efficient.