0.1 Lift solutions

When choosing our solution for the lifting of the fork it is important to specify the mast type before hand or decide on designing a modular solution, where different mast´s can be mounted depending on the request of the customers.

Those different mast types are called Simplex, Duplex, Triplex and Quadriplex which stand for the stage of the mast assembly and in essence for the maximum height it can operate at.

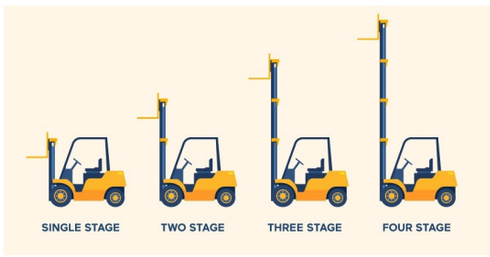


Figure 1: Stages

For each stage after the Simplex the freelift is also of interest, as states at which point the mast will extend. Having full freelift allows the forklift to lift the fork until the top off a Simplex stage without extending the mast, which makes the forklift useable in areas where not much overhead clearence is given, for example when emptying a truck.

0.1.1 Real lifting systems

Taking a closer look at the forklifts on the market, each lifting system is working with hydraulics. Reasons for this are:

1. Ability to switch forks easily(clamping, rotating, extra long and changing width)
2. Safety(Forks will never lower without permission) and no moving parts
3. Easy to maintenance
4. high power output
5. precise control

For lifting a hydraulic piston pushes a roller bearing up with a chain connected to an anchor on one side, rolling over it and connected with the fork on the other side. This creates a 2to1 lifting ratio where, 1meter lifted piston lifts the fork up 2meters.

0.1.2 Lifting solutions

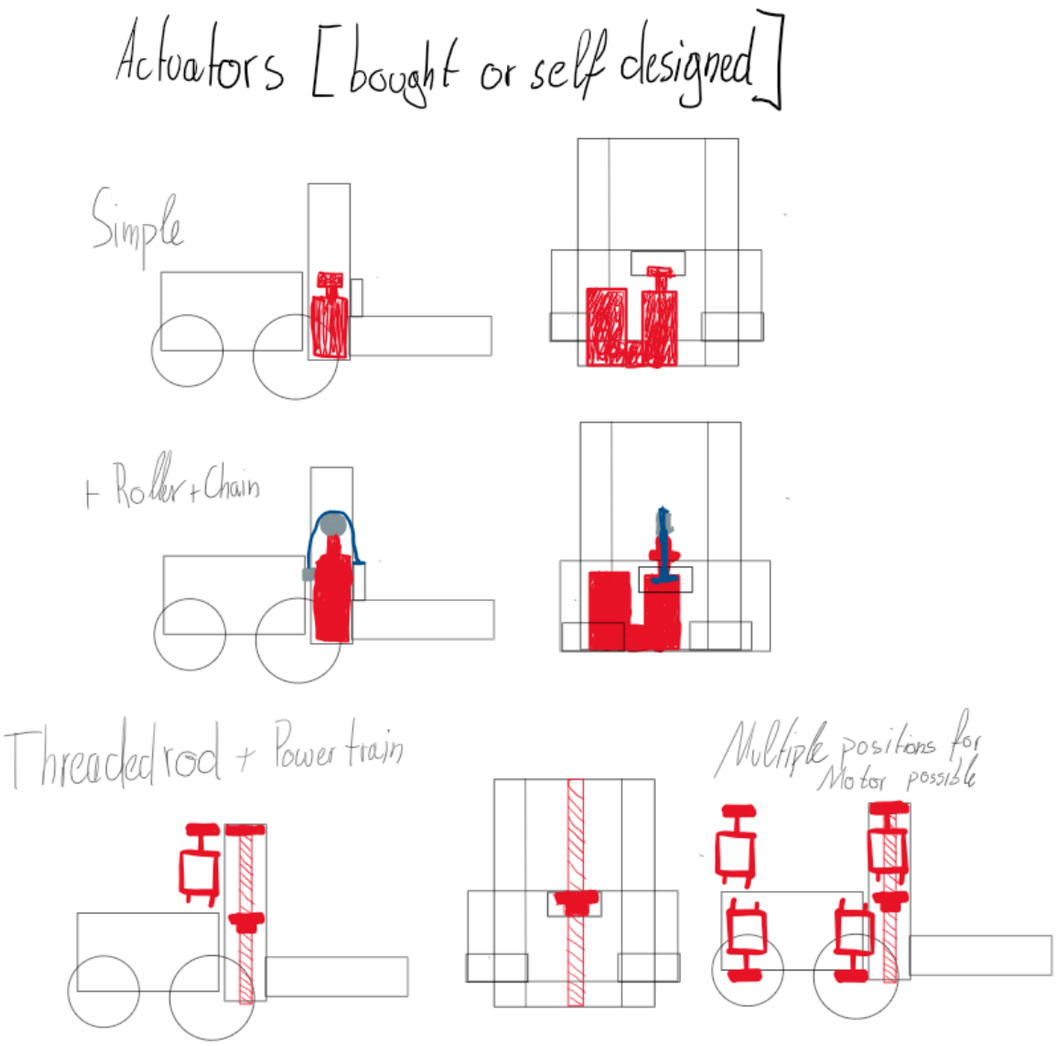
Because of the high cost, low weight of load we will carry and not having the focus on a accurate downscaled forklift we will not be able to use a hydraulic system for lifting. Using a roller-chain should be considered in each solution for better load distribution and less movement need due to the 2to1 ratio. Options can be:

1. Linear Actuator(Bought)
2. Linear Actuator(own design)(lead screw) threaded rod in
3. string+bearing
4. rack gear and pinion
5. //any combination out of those for higher stages

As our focus in this project lays on sensors and autonomous driving a Simplex stage 1 forklift will be enough of a mechanical task and could be upgraded if there is time to fill. Solutions could look like:

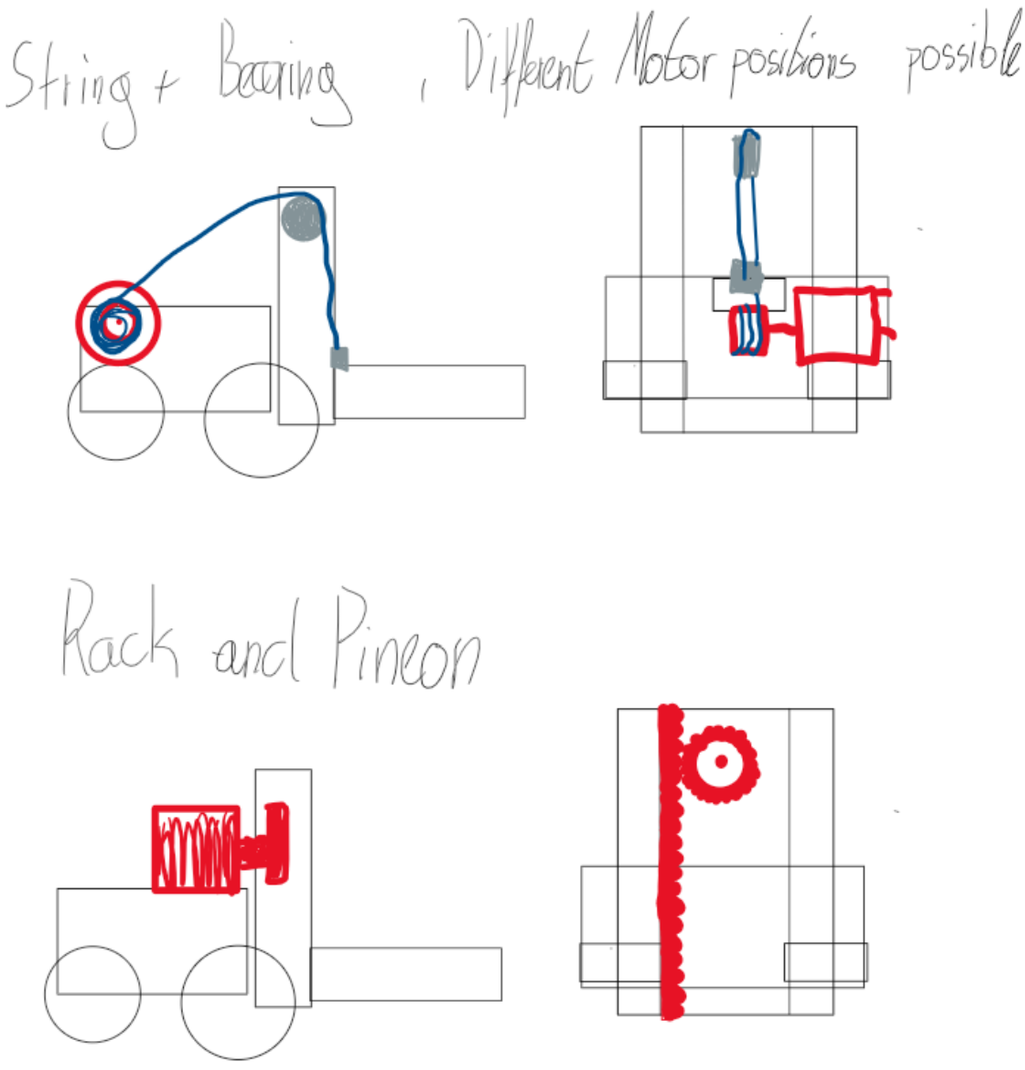
0.1.3 Lifting Calculations

To add a first value of safety the chosen system should be able to lift at least 30% (to be defined by a standard later) more than the maximum weight specification of our forklift. In this way we account for



H

Figure 2: Sketches: Lifting Solutions1



H

Figure 3: Sketches: Lifting Solutions1

variances and fatique of the components we are working with. We want to lift 4 soda cans per pallet and two pallets stacked which gives:

$$4 * 0.333 * 2 * 1.3 = 3.46kg$$

Including weight of pallets and fork into the 30% and rounding up would give a plausible 3.5 kg actual lifting force or $3.5 * 9.81 = 34.5N$ which our lifting solution should be able to to provide.