Rising Toilet Seat

Department of MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

Khoa Dinh, Jose Garcia, Cody Mitchell, Brandon Wilstead

Advisors: Dr. Bruce Gale, Dr. Bala Ambati

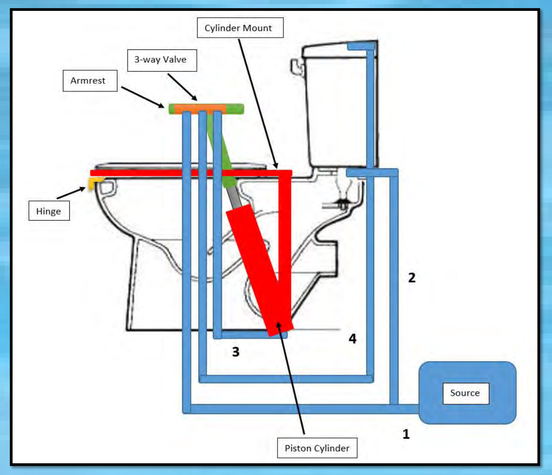
Introduction

Many elderly and persons with disabilities struggle to get on and off the toilet by themselves. Passive devices such as toilet seat boosters and handrails are often inadequate. Several active lifting devices are available, but these devices have several downfalls:

- Requires large batteries and power cords
- Too wide to fit in most residential bathrooms
- Expensive

An affordable and safe toilet lift is needed that doesn't require power cords or renovation!

Design



Lifting: The valve handle is turned to the 'lifting' position, which connects the water source to the hydraulic cylinders. This allows for flow into the cylinders, thus pushing the pistons and raising the seat.

Lowering: The valve is turned to the 'lowering' position, so the hydraulic cylinders are connected to the drain line to the toilet tank. The weight of the user pushes the seat down and expels the water from the hydraulic cylinders into the tank at a controlled rate. This allows the water to be later used for flushing the toilet.

Idle: When not in use, the valve can be left in either the 'lifting' or 'lowering' position. Water will not flow once the seat reaches the highest or lowest positions.

Advantages to Rising Toilet Seat

No batteries – the device is always ready to use

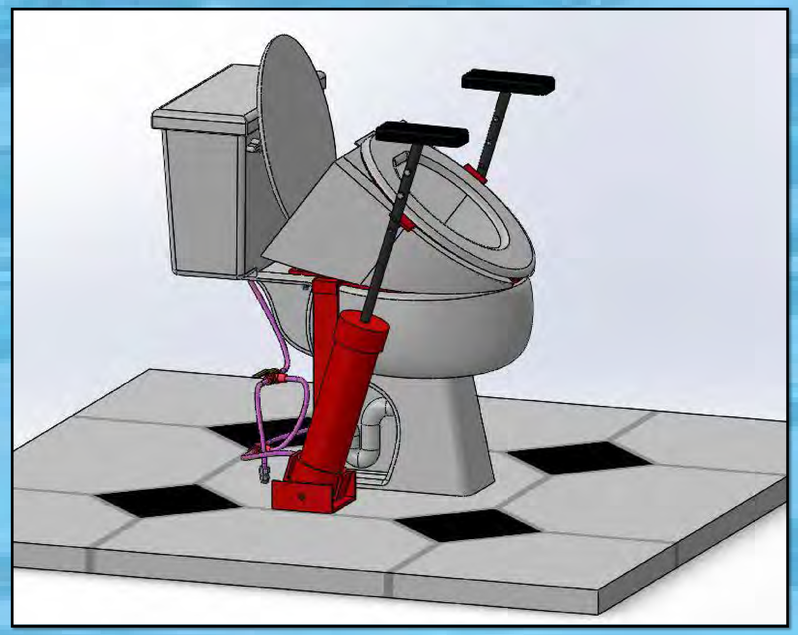
Compact – fits most residential bathrooms without renovation

Eco-friendly – uses less than 2 liters of water per cycle and the water is drained into the tank for flushing

Easy Installation – the device mounts in place of the toilet seat and uses the water line that supplies the toilet

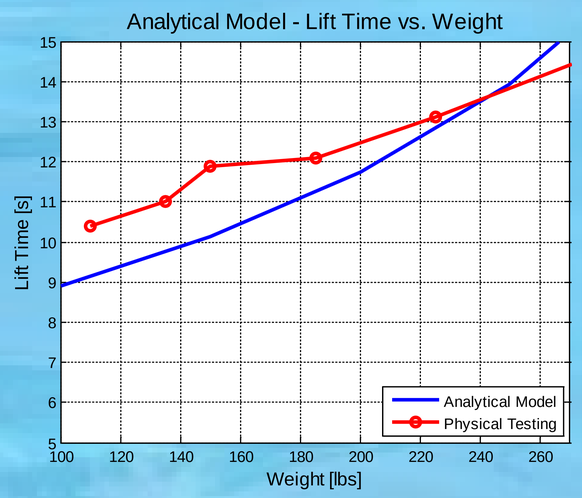
Cost – much cheaper than other solutions

3D Cad Model



Testing & Results

- 1st Phase: A Matlab analytical model was created to predict the device lifting performance. The model was used to design the device lifting geometry and hydraulic cylinder specifications.
- 2nd Phase: A physical stand-alone prototype was constructed to the test the critical lifting time and weight capacity.
- 3rd Phase: User testing was conducted with senior residents at Legacy Village Apartment Complex. The user's weights ranged from 100-280 lbs and ages from 62-97 years old. User feedback was vital for determining the 3-way valve placement as well as validating ergonomics and lifting performance of the device.



Metric	Physical Performance	Target Specs
User Weight Capacity [lbs]	280+	300
Install Time [hr]	<1	<2
Overall Width [in]	23.25	<25
Lifting Time [s]	10-15	14<s<23
Water Usage [L]	1.9	<3
Cost [$]	$275	<$1,000

Challenges

Problem: Need to power the device without batteries or power cords
Solution: Use existing water supply line as power source to operate device

Problem: Hydraulic cylinders vibrate when operated with water (instead of oil) at low pressure
Solution: Designed and built custom low pressure cylinders

Problem: Initial design was too wide to fit in residential bathrooms
Solution: Redesigned the lift mechanism to allow the hydraulic cylinders to be positioned closer together

Final Product

Conclusions

- Created a successful lift device powered by the toilet supply line
- Met all specifications except device lifting time was faster than specs from competitive benchmarking. However, user testing showed faster lifting times were comfortable.
- Users felt safe using the device
- A more ergonomic seat lifting motion would be beneficial

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