

Assistive Transfer Device

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Abstract

It is often difficult for patients to climb up onto a standard exam table. They struggle with the 10" step, built in to help them and current lifting methods are awkward and uncomfortable, so a new solution is needed. A new method for lifting patients the 10" necessary to sit on a standard exam table has been designed and built. The design involves lifting a platform using an electric motor and scissor cross links. The platform is very low to the ground and can be spun 180° to allow the patient to step onto the device and sit onto the exam table with minimal effort. A prototype for this design has been built and will be tested extensively in the future. Pending an IRB approval, a research study will also be completed to determine the most comfortable stepping height of elderly patients to ensure that this design maximizes patient comfort.

Assistive Lifting Methods

Patients often have difficulty getting up onto a standard exam table. Therefore, methods of assisting these patients have been developed:

Manual Labor

Nurses will often manually help patients onto the exam table. This involves grabbing the patients around the waist and lifting them onto the exam table.



<http://www.orgmed.com/images/patient-transfer.jpg>

Disadvantages:

- Uncomfortable for patient
- Requires heavy lifting for nurse
- Success is dependent on nurse's strength

Hoyer Lift

Named for one of the first companies to distribute it, the Hoyer lift uses hydraulics (or an electric motor) and a slings to lift a patients to the exam table^[2].



<http://hubpages.com/hub/hoyerlifts>

Disadvantages:

- Difficult to get patients into sling
- Used primarily for wheelchair bound patients

Device Specifications

The objective of this project is to make an assistive transfer device to lift an individual to a comfortable height for sitting on a standard exam table.

- Able to lift 300 lbs (Safety factor of 2)
- Lift 10 in. (height of exam table step)
- Rotate Patient
- Portable (Device < 50 lbs or on wheels)
- Easy Storage (under bed, behind door, against wall etc.)
- Stable during ascent and descent (patient comfort)

Final Design

The final design is composed of three specific problems that were analyzed and designed separately and put together into a combined design. The three separate systems included: lifting mechanisms, link geometry, and platform shapes.

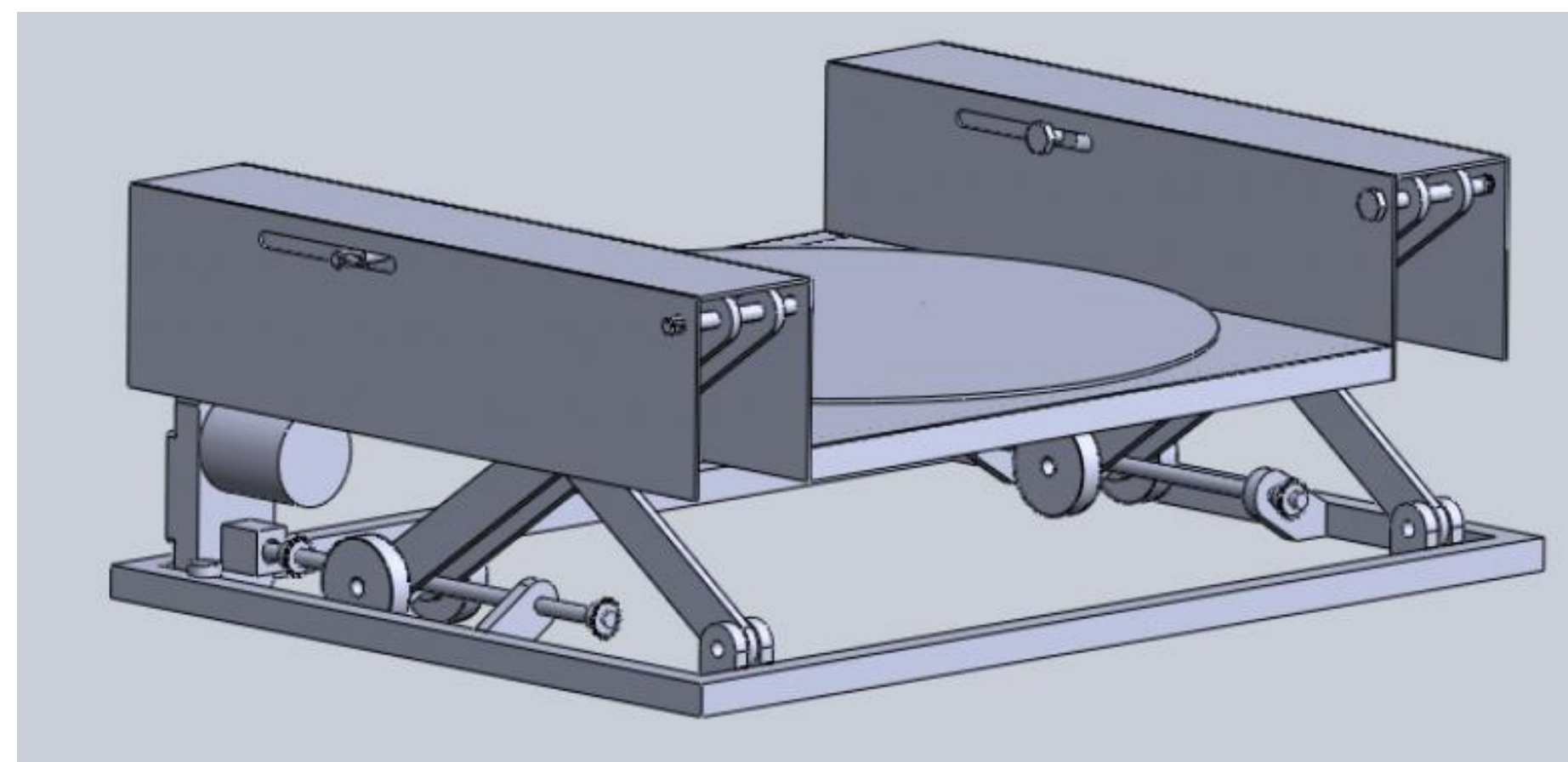


Figure 1 – SolidWorks drawing of the combined system

Lifting Mechanism

- Powered by an electric motor
- Motor turns a drive shaft that raises the platform
- Force is transferred to other side through a gear and pulley system

Platform Shape

- Raised sides to house links
- Circular turn table
- Support bars spaced to provide most support where needed as seen in Figure 2

Link Geometry

- Scissor links, pinned at the intersection point
- Pinned at one end and allowed to move freely in the horizontal direction at the other end

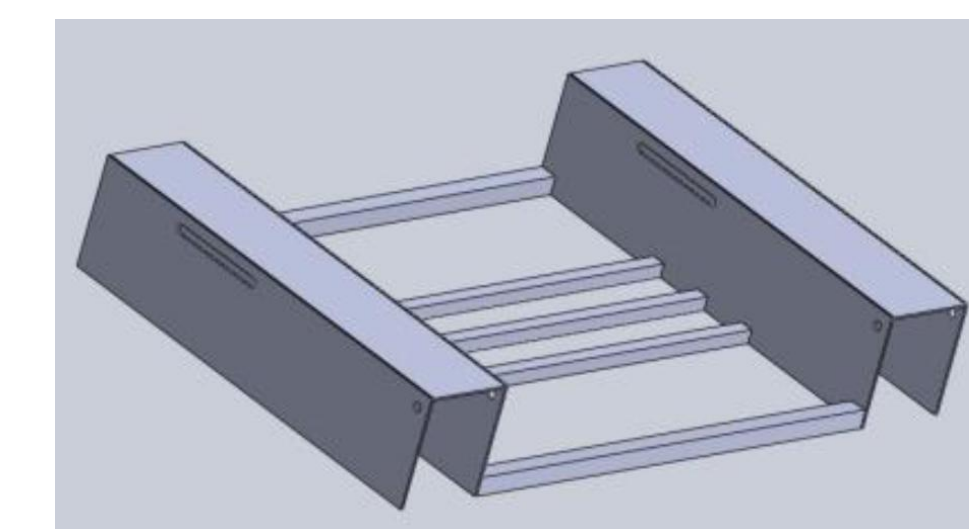


Figure 2 – SolidWorks drawing showing the location of the support bars under the turntable.

Finite Element Analysis

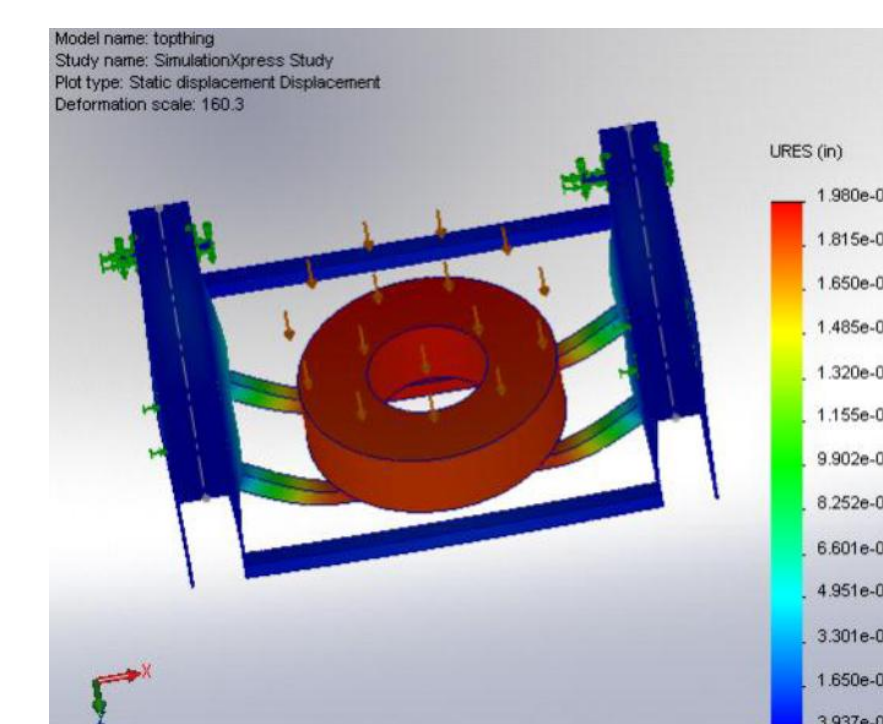


Figure 3 – Finite element analysis of the support bars showing the deflection as the weight is applied

Before building the prototype, a finite element analysis was done on two critical parts of the design. The support bars that the patient will be standing on and the point where the links meet the raised portion of the platform were analyzed. In both situations, the deformation was very small at the loads we were interested in.

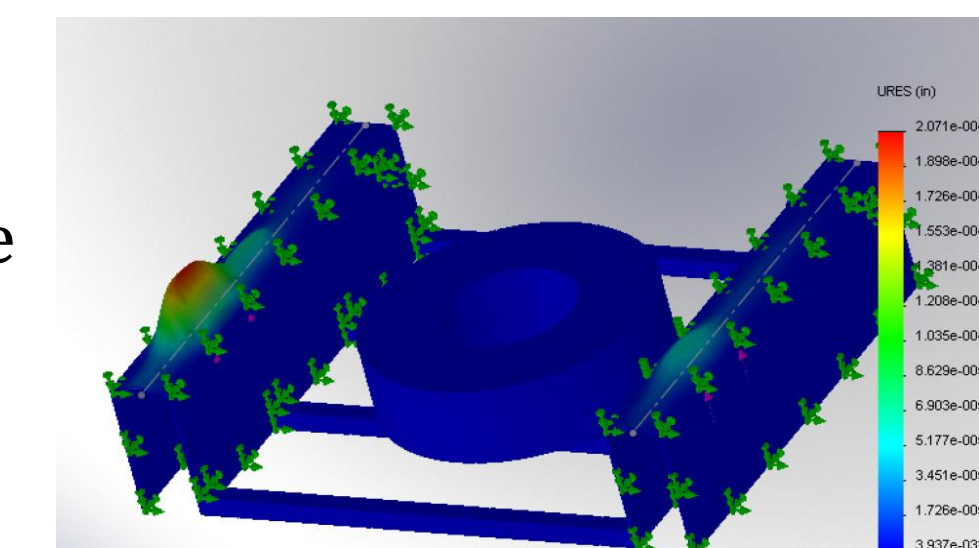


Figure 4 – Finite element analysis of link and platform connection

Previous Semester's Design

This is not the first design that has been developed for this problem statement. Last semester, a design was built and tested. It had many similar characteristics to the current design, including scissor crosslinks to lift the platform, utilization of a premade walker for patient support and a turntable to spin the patient 180°. The design had some flaws though, which needed to be reworked.

Needed Improvements:

- Reduce initial step height (3.5")
- Reduce total weight (60 lbs)
- Stability during ascent and descent
- Reduce friction on moving parts
- Automate

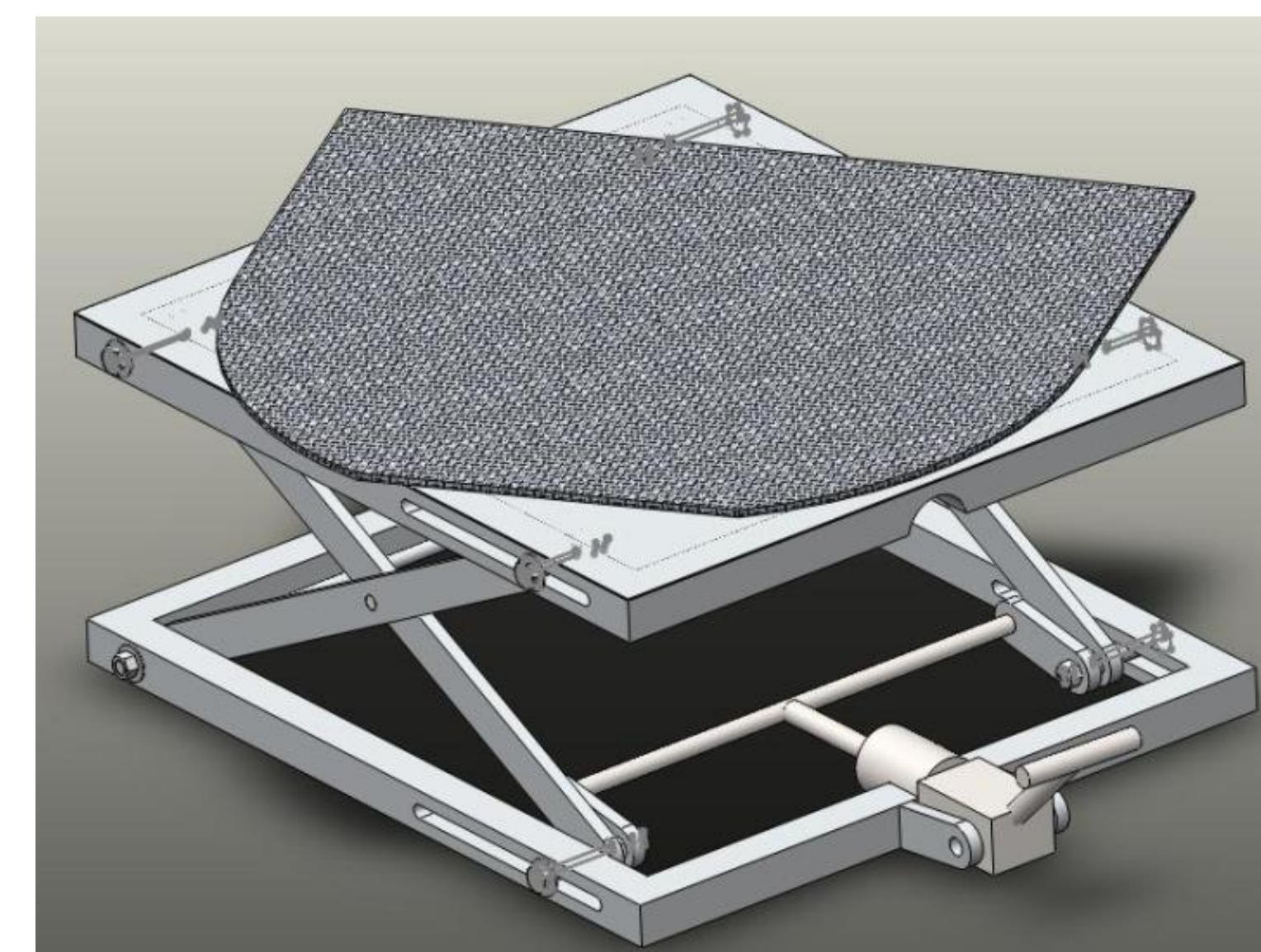


Figure 5 – SolidWorks drawing of the previous semester's design

IRB Research Proposal

A study will be conducted to determine the most comfortable stepping height and average stance width for elderly people. Current research indicates that the maximum knee flexion in elderly people (ages 75-93) allows for a 8" step, but does not account for difficulty or comfort^[1]. Approval through the Social and Behavioral Science Institutional Review Board pending.

Basic details of the study:

- Targeted population is nursing homes
- Subjects must be able to walk with the assistance of a walker
- Subjects asked to rate step heights based on comfort
- Subjects asked to fill out a survey
- Data used to determine max step height and width of the design



<http://www.imageenvision.com/cliparts/person-pg25>

Future Work

There are many important aspects of this project that can be improved in the future. Steps that will be taken in the near future and other potential improvements are:

- Mechanical testing and failure testing will be done on the prototype
 - Ensure safety of patients
- Research concerning step height and stance width (noted above) will be conducted and the results analyzed
- Improvements that can be made to the design itself:
 - Addition of wheels
 - Improve ergonomics
 - Walker attachment

Acknowledgements

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References

[1] Bergland A, Sylliaas H, Jarnlo GB, Wyller TB. Health, balance and walking as correlates of climbing stairs. J of Aging and Physical Activity 2008;16:42-52.
 [2] Simonton, Kevin, and Dana Wilcox. "Frequently Asked Questions About Portable Total Body Patient/Resident Lifts" Department of Labor and Industries: Nursing Home Initiative. <<http://www.wa.gov/lni/hlp/liftfaq.html>>.