Design and Fabrication of staircase elevator with lead screw mechanism for elderly people

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Abstract. The development of an indoor and outdoor stairlift is the primary goal of this Project. A chair that moves up and down a staircase on a leadscrew is known as a stair lift. While the primary concern when using the stairs is safety, modern, high-quality lifts come with a variety of features to maximise comfort, usability, and aesthetic appeal in the home. They are a safe and cost-effective solution to the special requirements and difficulties that people face when using the stairs, making them. With the aid of programmes like fusion 360 and autocad, we have created stairlifts designs.stair lifts are protablr cair-like mobility aids that are mounted on the side of stairways. They makes its easier for older individuals to makes between levels of ahome and allow many people with mobility challenges to live independently. Hence, we consider prototype with an different mechanism to reduce the cost of staircase with an offered price in the market everyone can and to cut down on production costs and the amount of time needed for escalators and elevators to be built, we are building a single leadscrew with stair elevator. Construction of escalators with stairs (stair lifts) that use a leadscrew mechanism to raise and lower the platform to transfer people. This aids the person who is having trouble climbing stairs.

1 Introduction

Using a staircase slider/lifter is a secure and reliable way to a mechanical device called a "human transportation" lifts and lowers individuals up and down stairs. The fact that the Elevators have seen numerous advancements up to the point where we may currently find them in markets or other public spaces.[1] An lift, often known as a lift, is a particular kind of vertical transportation tool, that effectively transports people and cargo between floors (levels) of a building or other structure [2]. Often driven by electric motors, elevators utilize different mechanisms such as pumping hydraulic fluid to elevate a cylindrical piston like a jack, or employing traction cables or counterweight systems similar to a hoist. In new multi-story buildings, elevators are frequently required by law due to wheelchair accessibility rules, especially in cases where wheelchair ramps would be prohibitive. As Along the rail, the chair or Platform moves, a person on it is raised, and products and the elderly are to be carried across the staircase. [3]The lift occasionally requires more depth. installation should be done underground, especially in multi-story buildings. Should a lift be added to the stalk structure, there will be a significant expense for modification. A large

portion of the city borders have been compacted to be closer to the facilities as a result of urbanisation, which began about two to three decades ago. This has led to high rise. The majority of residential buildings were permitted to rise up to 2 or 3 stories above the ground level without the use of an elevator. Since doing so was not thought to be necessary at the time, people opted to climb stairs despite all impediments. Residents in four-story buildings are already beginning to sense the need for elevators in their buildings as a result of lifestyle changes, including physical and mental apathy. However, several variables now abide by them, including local body regulations for town planning, construction requirements, and the price of installing a lift [4]. The concept of a stair case slider/lift was developed to address all of these issues and save the costs involved with civil construction and alteration. The system's benchmark is that this concept also entails simplification. Some claim that lifts originally started as straightforward rope or chain hoists. A platform that is mechanically pushed or lifted upward is what a lift essentially is a rail/leadscrew is attached to the side wall of adequately wide stairways.[5] Because of wheelchair or plate access laws and constraints such as power consumption and limiting access occupying a large area ,elevators have powerd electric motors that can drive either traction cable or lifting systems.The lifting platform is fastened to the rail; when the platform travels along the rail, a person standing on it is raised. Other names for staircase sliders include stair-lifts, chair lifts, stair gliders, and others.[6]. There is a law requiring elevators or escalators in shoppin centers and a selesct few multi-story buildings to help individuals with impairments. Stair lifts are mechanical devices that carry people or wheelchairs up and down stairs as needed, they can be used on both adequately wide steps amd narrow staircases.A plate or chair is attached to the rail for a person to an site Obviously powered by electricity, this slider has a motor, two rails, and a sliding platform. If the civil structure is not altered and a person is disabled, elderly or unable to raise themselves, they must still be carried across the stairway, this stair case slider can be put on stock stairs. As we previously indicated, a means of transportation is required in older buildings without lifts or with two or more storeys. Therefore, we conducted research to fill this gap that is now needed because it is simple to install, affordable, and does not require extensive maintenance.[7]Many stair lifts with unique features have been developed to meet the physical requirements of people with mobility impairments.

However, the use of steps and an escalator has generally been used as a lifting mechanism that is operated internally.invention of the escalator-stairlift ,Henry VII, King of England, created the first stair lift in the 1500s. The platform is raised using a pulley and tackle system that is operated by servants tugging the ropes. The king needed a stair lift since he had an accident in 1536 that severely injured his leg. Without access to medical services, the king built the stair lift. C.C. Crispen created the first commercial stairlift in the world in 1920, but he dubbed it "The Inclinator." To make it easier for his ailing friend to climb and descend the stairs, Crispen invented this contraption.[8]Elevators are equipped with powered electric motors that can operate counterweight or traction cable systems. Due to wheelchair accessibility regulations, electricity consumption, limited access, and taking up a lot of spaceThe ability to design and control machines in any way is now possible thanks to advancements in robotics. In 1987, based on the studies on quadruped walking , university of llinois at Chicago and the veterans administration hines rehabilitation Research amd Development centre created a foure-legged chair.[9] The elderly and physically challenged may find it easier to ascend stairs with the aid of a stair case. The welfare of the disabled is given greater priority in today's industrialised society. Since the barrier-free law went into effect, lifts, stair climbing aids like rails and wheelchairs équipement have been installed in public places and train stations to increase the outdoor moving space for people with disabilities who can only move long distances in wheelchairs. However, due to the high cost and limited space, not all public spaces, including tiny

stations, theatres, and hospitals, can accommodate the installation of such equipment. In contrast, almost all public spaces have additional little steps or impediments in addition to the usual flight of lengthy stairs. It is essential to develop a type of secure, uncomplicated, affordable, and unaffected-by-the-environment cable drive platform so that people with disabilities can simply move through various types of barriers. In other terms, it's an effort to develop a mobile vehicle that can aid in movement or stair climbing.[10]An experimental prototype that had pantographic legs operated by a computer and walked with a straightforward linear gait was demonstrated in October 1998. Despite the fact that it made use of a stationary controller with a complex design, it was not carrying any passengers.

2. Littérature review

To make it easier for those with physical disabilities to navigate stairs, S. Hirose and J. Yuan proposed creating a specific form of mobile vehicle that can steadily climb stairs. Since the mechanism is based on eight streamlined legs, it functions best during stair climbing action. They first introduced the Zero Carrier, a cutting-edge hybrid stair climbing vehicle with eight prismatic joint legs that delivers a great deal of stability. [11] A motorised leadscrew allows the chair's occupant to move down the rail. Stair lifts are also referred to by a variety of names, including stairlifts, chairlifts, and stair gliders.[12] On 5 May 2016, P.Jey Praveen Raj, P.M.Mohamed Fuge, R.Paul Caleb, and G.Natarajan designed and fabricated a Stair Climbing Trolley. The project's major goal is to discover a practical and user-friendly way to carry various goods up stairs while requiring the user to exert the least amount of effort possible and to also deliver a smooth ascent. A trial model of the zero carrier is built using the sensors necessary for stable mobility.With a gross weight of 3 kg and the use of light weight aluminium alloy components, A flexible wearable chair prototype was developed by A. Bijalwan and A. Misra that resembles a light exoskeleton and enables users to sit anywhere and in any working position.[13] People will be given the independence they require to move about their homes by installing the Excel stairlift system The prototype's usage of kinematic pairings allowed it to stop in any working position and between continuous moments. The writers mainly concentrated on the prototype's mechanical design and FEA analysis. For people with mobility issues, stairs into buildings can be a substantial obstacle, according to Johanne L. Mattie.Therefore, the author suggested creating a revolutionary, inclusive solution that integrates a stairway and a lift into a single apparatus.When there are staff shortages, technical assistance is needed, as Michael Hinderer noted. introducing the "autonomous stair climbing wheelchair" for transferring people with restricted mobility. [14]A unique remote centre system that allows a wheelchair to glide up stairs has been proposed. In this system, regardless of the angle of the wheelchair, the seat's attitude changes along with the user's angle of inclination. The autonomous stair-climbing wheelchair is supported by two legs, one of which has lower leg support and the other of which has upper leg support. [15] Bernt Carstens created a motor-driven stair climbing gadget in 2002 to transport equipment and commodities, especially wheel chairs for people with disabilities.

3. Methodology

The Platform Stairlift was developed using a rigorous, user-centered design process that takes the leadscrew drive (nut and lead screw mechanism) into consideration.Using a motorised leadscrew-based nut system is an easy and practical technique to hoist disabled patients up stairs. The platform in this will be fastened A stiff support would connect a vertical frame to a leadscrew mechanism. The leadscrew mechanism and the entire platform body are connected by the stiff support. The nut will follow angled straight guide as it moves.The fundamental working principle is the pulling force. The platform body's link will be secured by the motorised leadscrew.[16] Electronic parts of the platform stairlift . includes all important safety elements, such as limit switches.

4. Modification

In a machine, a leadscrew (or lead screw), also known as a power screw or translation screw, is used as a linkage to convert turning motion into linear motion. Due to the size of the sliding contact area between the male and female parts of screw threads, they experience greater losses in frictional energy than other links. Sometimes, a lead screw is used together with a split nut (also known as a half nut) which allows the nut to be axially moved independently of the screw's rotation, such as during single-point threading on a manual lathe. Additionally, a split nut can be used to compensate for wear by compressing its components. [18] After the lifts are installed, changes will be very difficult to make, which will drive up the cost. The platform is essentially pulled or pushed by mechanical means by the elevators.We know that in the market many staircase lifter is available with different mechanism like rope and belt drive ,rack and pinon, gear drive with an huge amount due that middle class people can't offord it so to overcome this problem we have decided to modify the staircase elevator with decreased of extra fitting and mechanism of a leadscrew mechanism initated with nut and threaded along screw.[19] Electric linear actuators frequently use leadscrews as a part. A lead screw is a screw that transforms rotational motion into linear motion and is frequently employed as the driving mechanism in applications that are driven horizontally or vertically. Linear guides provide guidance and help. The diameter and pitch of lead screws are used to define them, with pitch or lead referring to the distance that the nut travels along the screw during each full rotation. They can be run by a motor or by hand. [20] In addition to having high positional accuracy, very low friction, and very little wear, a hydrostatic leadscrew also requires continuous supply of high pressure fluid and highly precise manufacturing, which drives up the cost significantly more than most other linear motion.

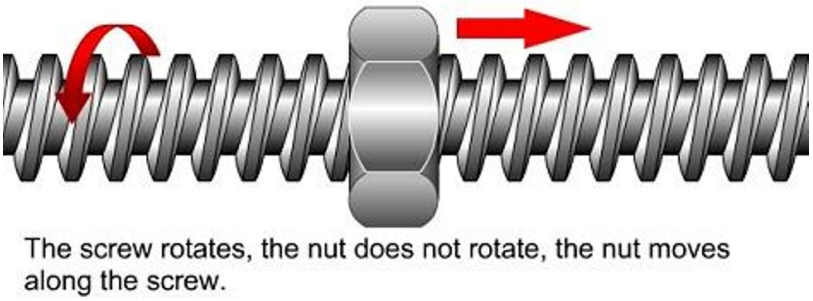

Fig.1 .leadscrew with nut rotation direction

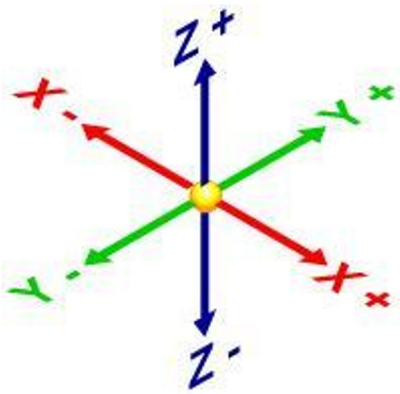

Fig.2. axis of lead screw mechanism

[20]We can utilise 0.3 to 0.5% C in medium carbon steel for the shaft. Materials C40, C45, and C50 are available. According to a local market assessment, EN8 is a highly frequent and inexpensive material for producing lead screws because of its accessibility and cost.

Fig.3. Attachement of lead screw

5. Designing the prototype model by using autocad and fusion 360 softwares

5.1 *specifications of staircase lifter*

Table1. Specifications of stair case lifter

Base staircase Dimensions (l x b x t)(mm)	950 x 750 x 2
Leadscew(ACME THREAD) (l x t)(mm)	902 x 10
Bearings	10mm
DC MOTOR	12V ,60RPM
MATERIAL	MILDSTEEL
DPDT Swtich	plastic

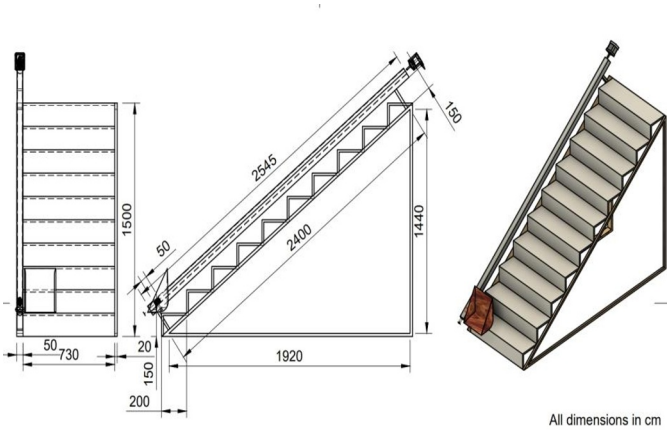

Fig.4. Design specifications of drawing

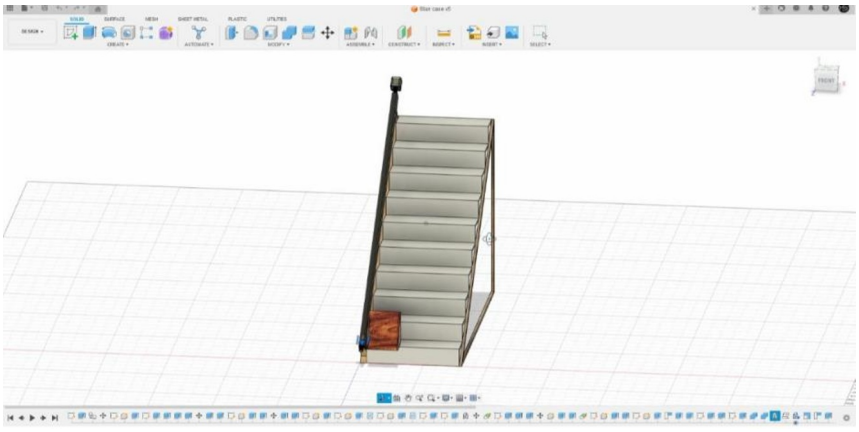

Fig.5. Front view of the cad model

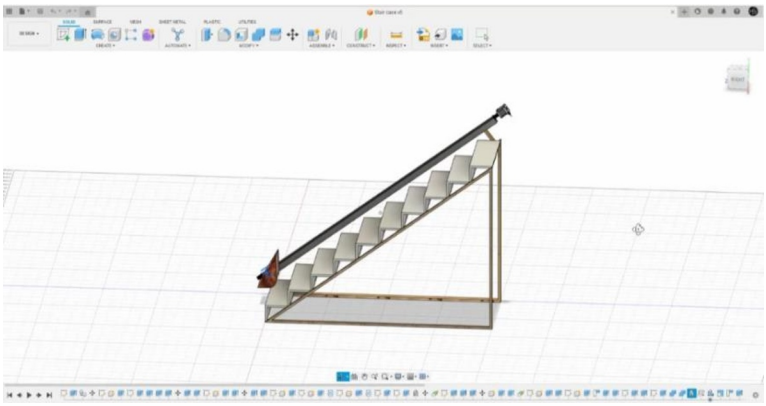

Fig.6. Front view of the cad model

6. Deisgn Procedure

Marking the dimensions then cutting and fabricating all the components.

Fig.6. Marking dimensions (step -1)

Fig.7. Fabrication of stair case (step -2)

Fig.8. Asssembling the mechanism to the staircase (step -3)

Fig.9. Finished prototype of a staircase lifter(step-4)

7. Conclusion

In this study, we proposed an portable type stair case lifter with different mechanism that is leadscrew mechanism that offers a simple means of stair mobility for the elderly and physically challenged. Once the motor is connected to the electric, you may quickly use One can climb or descend the steps using the limiting switches. We can overcome the cost by implementing this mechanism we have made the prototype project . It has been fabricated , and a practical done by lifting 1kg of bottle has been conclude for the platform stairlift mechanism with leadscrew mechanism. The design is built on easily accessible, inexpensive components.

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