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"Literature Review for Staircase Slider Mechanism for Person with Lack of Mobility"

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ABSTRACT

Preserving the mobility of elderly people is becoming increasingly important, as other factors of quality of life. Products that preserve the mobility of elderly people can therefore significantly improve their independence and lifestyle. Based on the changes in the age structure of society, demographic change also means to increasingly utilize available support by technical systems to allow people a self-dependent and self-determined life. This review research is established for determining various modes for modification in the homes where people spend large part of their lives especially focusing on the homes of disabled, who likely to spend more at home.

Keywords: Design for elderly people; mobility

I. INTRODUCTION

Senior citizens or persons with physical disability, a fall can mean the loss of independence and mobility. Often due to osteoporosis, bones are much more fragile, so a low impact fall can quickly turn into injury. Up to 15% of falls result in injuries, the most serious of which is hip fracture and up to half of all people who have a hip fracture never get back to their previous level of independence. The risk factors for falls among older people can be classified into three categories: intrinsic, extrinsic and exposure to risk (Todd and Skelton, 2004). Intrinsic factors include age, gender, living alone, medicine, medical conditions, impaired mobility and gait, nutritional deficiencies, impaired cognition, visual impairments, and foot problems. Extrinsic factors include poor lighting, slippery floors, uneven surfaces, footwear and clothing, inappropriate walking aids or assistive devices. Exposure to risk concerns levels of activity and inactivity. Intrinsic factors are considered more important among people aged 80 and over (suggesting they are less active) and extrinsic factors more important among older people under 75 (suggesting they are more active). Of all the areas in the home, the staircase is the most frequent place for a fall and is also the most likely place to cause injury. It is common for senior to become anxious on the stairs, even more so if they had a previous falls. This anxiousness can also increase the risk of a fall, which is why remaining calm is so important. The person might also decide

to simply avoid attending those areas where stairs are only means of reach. While effective to a degree, they do not really or fully address the actual issue at hand, which is being able to use the stairs safely and with confidence.

In this context, the focus of considerations related to mobility support by technical systems are elderly people respectively people with performance restrictions. Not only because of the variety in the occurrence of performance restrictions but also by the diversity of biographies (social integration, career, life experiences), elderly people are a very heterogeneous group with diversified needs and requirements for technical systems.

According to Census 2011, India is having 8 % of total population lying in the age group bifurcation of + 60 and 2.21% of total population in the category of people with movement disabilities which make these groups dependent on others to aid them in various chores of day to day life in public and where as in their own homes too.

The urbanization started some 20 years ago and has taken much of the City limits to get compressed nearest to the amenities which resulted in high rise. Most residential buildings were granted the permission to build up to Ground plus 2 or 3 storied, wherein Elevator was not installed. Since at that time, it was not considered necessary and people preferred to climb stairs, irrespective of all odds. Consequent to the Life-Style changes, including physical and mental apathy, currently the four storey building residents have started to feel the need for having a Elevator in their buildings. But now many factors abide them such as local body governing rules for town planning, constructional requirement and cost of installation of the Elevator.

II. VISION FOR THIS RESEARCH

A comprehensive approach to mobility does not only conduce to great potential for innovation for mobility support. The challenge for project development is also to consider the variety of influencing factors that determine the requirements for mobility-aided systems and the associated possibilities for finding solutions. This review is a preliminary step which will assist me taking correct decisions in concern with design and calculation for slider mechanism.

Transmission drives that can be used for moving the slider up/down the side rail :-

A. Power screws

A lead screw also known as a power screw or translation screw, is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioned mechanisms.

Advantages of a leadscrew

I. Large load carrying capability
II. Compact and Simple to design
III. Large mechanical advantage
IV. Precise and accurate linear motion
V. Smooth and quiet
VI. Minimal number of parts
VII. Most are self-locking

Disadvantages of a leadscrew

I. Not very efficient - due to the low efficiency they cannot be used in continuous power transmission applications.

II. They also have a high degree of friction on the threads, which can wear the threads out quickly. For square threads, the nut must be replaced; for trapezoidal threads, a split nut may be used to compensate for the wear.

B. Chain drives

Chain drive is a way of transmitting mechanical power from one place to another. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

Advantages of chain drive

I. Do not slip or creep, and so are more efficient than belt drives
II. Are more compact than belt drives
III. Operate effectively at high temperatures
IV. Are often easier to install than belt drives
V. Do not deteriorate due to oil, grease, sunlight, or age
VI. Can withstand abrasive conditions
VII. Can operate in wet conditions
VIII. Can be used on reversing drives

Disadvantages of chain drive

I. Cannot be used in applications where the drive must slip
II. Require more precise alignment than belt drives
III. Typically require frequent lubrication
IV. Are noisy and can cause vibrations
V. Do not have the load capacity or service life of gear drives

C. Rope drive

Rope drive (do not mistaken with round belt) is used where a large amount of power is needed to transfer for a long distance (more than 8m). The rope runs over a grooved pulley. There are two types rope drive Fiber Rope and Wire Rope.

Advantages of rope drive

I. Significant power transmission.
II. It can be used for long distance.
III. Ropes are strong and flexible.
IV. Provides smooth and quiet operation.
V. It can run any direction.
VI. Low-cost and economic.
VII. Precise alignment of the shaft not required.

Disadvantages of rope drive

I. Internal failure of the rope has no sign on external, so it if often get unnoticed.
II. Corrosion of wire rope.

D. Belt drive

A belt is a looped strip of flexible material used to mechanically link two or more rotating shafts. A belt drive offers smooth transmission of power between shafts at a considerable distance. **Belt drives** are used as the source of motion to transfer to efficiently transmit power or to track relative movement.

Advantages of belt drives:

I. Belt drives are simple are economical.
II. They don't need parallel shafts.
III. Belts drives are provided with overload and jam protection.
IV. Noise and vibration are damped out. Machinery life is increased because load fluctuations are shock-absorbed.
V. They are lubrication-free. They require less maintenance cost.
VI. Belt drives are highly efficient in use (up to 98%, usually 95%).
VII. They are very economical when the distance between shafts is very large.

Disadvantages of belt drives:

I. In Belt drives, angular velocity ratio is not necessarily constant or equal to the ratio of pulley diameters, because of slipping and stretching.
II. Heat buildup occurs. Speed is limited to usually 35 meters per second. Power transmission is limited to 370 kilowatts.
III. Operating temperatures are usually restricted to –35 to 85°C.
IV. Some adjustment of center distance or use of an idler pulley is necessary for wearing and stretching of belt drive compensation

E. Gear drives (Rack and Pinion)

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion.

Advantages of Rack and Pinion

I. Cheap
II. Compact
III. Robust
IV. Easiest way to convert rotation motion into linear motion
V. Rack and pinion gives easier and more compact control over the vehicle

Disadvantages of Rack and Pinion

I. Since being the most ancient, the wheel is also the most convenient and somewhat more extensive in terms of energy too. Due to the apparent friction, you would already have guessed just how much of the power being input gives in terms of output, a lot of the force applied to the mechanism is burned up in overcoming friction, to be more precise somewhat around 80% of the overall force is burned to overcome one.
II. The rack and pinion can only work with certain levels of friction. Too high a friction and the mechanism will be subject to wear more than usual and will require more force to operate.
III. The most adverse disadvantage of rack and pinion would also be due to the inherent friction, the same force that actually makes things work in the mechanism. Due to the friction, it is under a constant wear, possibly needing replacement after a certain time

III. REVIEW OF LITERATURE

1.1. Platform of Design Method for developing mobility-preserving products: [1] Elderly people partly have individual barriers in handling technical systems as well as in the use of public and private spaces. Uncertainty and fear of handling technical systems have to be taken seriously as well as aspects of stigmatization to ensure the acceptability of the product. The user does not want and should not be necessarily confronted with the entire complexity of technical systems. Any forms of barriers in the use of technical aids have to be avoided. Elderly people need a sustainable support by technical systems. The support should be available so far as it is necessary to obtain or to train the performance. Only when this is no longer sufficient to satisfy mobility needs, the technical system should compensate the lost

performance (support hierarchy). For the derivation of technical aids a holistic mobility model is required that reflects not only the mobility situation but also considers individual conditions and social factors as well as the characteristics of public and private space more closely. The methodological development of product lines requires an implementation of the analyzed situations of mobility into concrete requirements. With these factors, the requirements related to the product line can be completed in terms of acceptance and concomitantly deliver reference criteria to ensure a process attendant property validation.

1.2. Tall Buildings and Elevators: A Review of Recent Technological Advances: [2] Efficient vertical mobility is a critical component of tall building development and construction. This paper investigates recent advances in elevator technology and examines their impact on tall building development. It maps out, organizes, and collates complex and scattered information on multiple aspects of elevator design, and presents them in an accessible and non-technical discourse. Importantly, the paper contextualizes recent technological innovations by examining their implementations in recent major projects including One World Trade Center in New York; Shanghai Tower in Shanghai; Burj Khalifa in Dubai; Kingdom Tower in Jeddah, Saudi Arabia; and the green retrofit project of the Empire State Building in New York. Further, the paper discusses future vertical transportation models including a vertical subway concept, a space lift, and electromagnetic levitation technology. As these new technological advancements in elevator design empower architects to create new forms and shapes of large-scale, mixed-use developments, this paper concludes by highlighting the need for interdisciplinary research in in corporating elevators in skyscrapers.

1.3. Mathematical models used in gear dynamics—A review: [3] With increased demand for high speed machinery, the mathematical modelling of the dynamic analysis of gears has gained importance. Numerous mathematical models have been developed for different purposes in the past three decades. In this paper the mathematical models used in gear dynamics are discussed and a general classification of these models is made. First, the basic characteristics of each class of dynamic models along with the objectives and different parameters considered in modeling are discussed. Then, the early history of the research made on gear dynamics is summarized and a comprehensive survey of the studies involved in mathematical modelling of gears for dynamic analysis is made. Generally, a chronological order is followed in each class studied. The goal is not just to refer to several papers published in this field, but also to give brief information about the models and, sometimes, about the approximations and assumptions made. A considerable number of publications were reviewed and 188 of them are included in the survey.

1.4. Designing and analysing stair case lift system:[4] A stair case lift is a safe and secure method for human transportation which is a mechanical device for lifting people and wheelchairs up and down stairs. As we know

the elevators had been made a lot of developments until it reached to the elevators that we see nowadays in the markets or other places. Sometime the elevator needs extra depth underground for installing and especially in the tall buildings that are consist of many storeys. The argument of people about lifts began with simple rope or chain. The development of industries and beam construction together is the main reason to improve the technology of elevators that we see nowadays. After the installation of the lifts the alteration will be very difficult so the cost will be too much. The lifts basically depend on mechanical means either pulling or pushing the platform. In the old buildings that do not have elevators or consist of two floors must have a device for transportation as we mentioned before. So we made a research to fill this blank, because it is easy to install and cheap and not needed maintenance. We will mount two rails to the stairs one of them for connecting the track gear and the other for supporting. The attachment of lifting platform or chair to the rail is done by using rack and pinion. The device is working by D.C. motor which gives motion to chair or platform by gears.

1.5. Design and Finite Element Analysis of a Stair Case Material Handling System: [5] : This topic deals with the fabrication and analysis of a stair case lift, which can be use as Material Handling System. A stair case lift is a mechanical device for lifting people and wheelchairs up and down on the stairs, who may find difficulty in doing so themselves. In this paper, the final design was an outcome of a sequential analysis and modification of stages. And it was deduced that Stair lifts are easily installed into any situation where the condition of the stair tread is good as the railing that the chair lift uses is attached to the stair tread. During the test run of this project, it was realized that the model would be capable of carrying heavy load without suffering any deformation or local fractures if it would go into real world production at an ideal scale Therefore it can be widely used for home as well as industrial which ensures a promising future to the concept.

IV. OVERVIEW

Staircase slider is defined as a lift in the form of a platform that can be raised or lowered at the edge of a domestic staircase, used for carrying a person with walking difficulties. Once it has become too difficult to climb the stairs, one might decide that the house will need to be rearranged so that there is a bedroom and a bathroom downstairs, or he/she will decide to move to a bungalow with no stairs to climb. Staircase slider can provide a `great deal of freedom and independence, and can mean that there's no need to transform current house arrangement or to move to a bungalow, or build an extension.

V. CONCLUSION

The proposed work is determined for design and fabrication of staircase slider for persons with physical difficulties to climb the stairs by their own. Staircase slider will be a mechanism for home lifting aid that will allow an individual to slide over the staircase as well as can utilize the same staircase for pedestrian purpose also. The slider mechanism will carry an individual up the stairs, attaching directly above the staircase railing. In this case, an individual must remain standing as they use this slider. This design will not require overhead control room and it will not be necessary to have structural alteration to

the building. The only basic requirement will be that staircase width should be at least in between 75cm – 100cm in width.

VI. METHODOLOGY

- Data accumulation
- Literature survey
- Selection and Design of drive system
- Design of slider platform
- CAD modeling of staircase slider system
- Analysis of design
- Modification of design if required after analysis
- Result discussion
- Design validation
- Design finalization

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