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Design and Development of Convertible Staircase Cum Ramp for Physical Disabled Persons

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Abstract: *Generally, at many places there is no provision for disable people to climb the stairs with the help of this mechanized stairs the person will be able to do it. The objectives to transmute the staircase into ramp or platform, so that lame or disable people can make use of it. It is amalgamation of stairs and ramp so it can use alternately whenever needed, it is a type of portative stairs. Involvement of such mechanized things will help to reduce human work. The main rationale behind working on this topic is to reduce human effort in day-to-day life and vanquish the difficulties. The work is done to bring the conceptual idea into reality. The main concept of mechanized stairs is creating combination of stair and ramp by implementing mechanical linkages, different mechanism so that it can bemuse simultaneously as a stair or ramp as per use or need. As per contemplate there is a major predicament for disable people for climbing stairs so this idea was conceptualized by integrating with mechanical systems. By considering the concept, the fabrication was carried outdo prepare the stairs by fulfilling three basic requirements economic viability, technical feasibility and social acceptance.*

Keywords*:* Ergonomics, Convertible Stair Case, Ramp, disable people problem solving

I. INTRODUCTION

Generally, at many places there is no provision for disable people to climb the stairs with the help of this mechanized stairs. The person will able to do it. The objective is to transmute the staircase into ramp or platform, so that lame or disable people can make use of it. It is a amalgamation of stairs and ramp so it can use alternately whenever needed, it is a type of portative stairs. Involvement of such mechanized things will help to reduce human work. The main rationale behind working on this topic is to reduce human effort in day-to-day life and vanquish the difficulties. The work is done to bring the conceptual idea into reality. There are many old and physically disable peoples in the world and it is difficult for them to climb stairs as compared to normal persons. So to help them and to help the persons who cannot afford lift as their houses are small, the project is made. The most concern of this project is to fabricate a mechanism which will lift them up and put them down whenever they want and at very low budget. A stair with escalator is a mechanical device for lifting people up & down. Rail is mounted on the stairs on which a platform is attached. The platform is lifted by a simple mechanism of rope & pulley by it is lifted. Person gets on the platform is lifted when he/she switch on the plug the motor starts, after that the shaft of motor is connected to gearbox (speed reducer) by the Oldham's coupling. The outlet shaft of gearbox is connected to another Oldham's coupling which transmits the power to the spindle to wind or unwind the rope. Winding the rope will lift the platform up & unwinding will make the platform go down. A Stair is a combination of steps by which people may pass from one level to another. It is a contiguous set connecting two floor or surface on different level. Stairs are constructional design to bridge up the two platforms which are not on the same level. Stair case may be of different design like straight, circular as per execution or constructional design they are used. Some alternatives to stairs are elevators, stair lift sand inclined moving walk ways. Stairways into buildings present a significant environmental barrier for those with mobility impairments, including older adults. A number of home access solutions that allow users to safely enter and exit the home exist, however these all have some limitations. The purpose of this work was to develop a novel, an inclusive home access solution that integrates a staircase and a lift into one device.

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1.1 Problem Statement:

The main concept of mechanized stairs is to ready a combination of stair and ramp by implementing mechanical linkages, different mechanism so that it can be use simultaneously as a stair or ramp as per use or need. As per contemplate there is a major predicament for disable people for climbing stairs so this idea was conceptualized by integrating with mechanical systems.

1.2 Objectives of Project:

1. To understand the concept, design & development of Convertible Stair Case.
2. Ramp to find further scope for Improvement.
3. To find the possible ways of Staircase & Ramp structure enhancement.
4. To optimize the possible combinations of Staircase & Ramp this will be helpful for disable people problem solving.
5. To find ergonomics ways of making Convertible Staircase to Ramp for disable people.

II. LITERATURE REVIEW

David R. Bassett, Ray Browning, Scott A. Conger, Dana L. Wolff, and Jennifer I. Flynn, done the work on, Architectural Design and Physical Activity: An Observational Study of Staircase and Elevator Use in Different Buildings, according to his study, The indoor built environment has the potential 'to influence levels of physical activity. However, the extent to which architectural design in commercial buildings can influence the percentage of people choosing to use the stairs versus elevators is unknown. The purpose of this study was to determine if buildings with centrally located, accessible, and aesthetically pleasing staircases result in a greater percentage of people taking the stairs. Methods: Direct observations of stair and elevator use were conducted in 3 buildings on a university. One of the buildings had a bank of 4 centrally located elevators and a fire escape stairwell behind a steel door. The other 2 buildings had centrally located staircases and out-of-the-way elevators. The percentage of people who ascended the stairs was 8.1% in the elevator-centric building, compared with 72.8% and 81.1% in the 2 stair-centric buildings (P < In addition, the percentage of people who descended the stairs was 10.8% in the first building, compared with 89.5% and 93.7% in the stair-centric buildings (P < -001), Conclusions: The results of the current study suggest that if buildings are constructed with centrally located, accessible, and aesthetically pleasing staircases, a greater percentage of people will choose to take the stairs. In summary, this study's observational data suggest that centrally located, accessible and aesthetically pleasing staircase design contribute to Increased stair use. We compared the percentage of people using the stairs in two buildings with well-designed staircases to another building with a centrally located bank of elevators and a narrow, fire-escape stairwell. The percentage of stair users was several times greater for the stair-centric buildings, compared with the elevator-centric buildings. If implemented on a widespread basis, this architectural design change could boost population levels of physical activity and reduce electricity use. [1]

Venkatesh B. Emche, Nikhil G Lokhande, Amit S.Ghade, Chetan A Samarth, done the work on, Development of Stairs with Escalator (Stair lift), according to his study, This Paper deals with fabrication of stairs with escalator (stair lift) which consist of rope and pulley mechanism which lifts up and down the platform to move person. This helps the person to facing difficulties in climbing stairs. We propose equipment which be handled easily by the person, since it is a mechanical engineering project. Our major requirement was 'that to make the project at low budget as compared to lift with low maintenance without risk of power cut & human life. There are many old and physically disable peoples in the world and it is difficult for them to climb stairs as compared to normal persons. So to help them and to help the persons who cannot afford lift as 'their houses are small, the project is made. The most concern of this project is to fabricate a mechanism which will lift them up and put them down whenever they want and at very low budget. stair with escalator is a mechanical device for lifting people up & down. Rail is mounted on the stairs on which a platform is attached. The platform is lifted by a simple mechanism of rope & pulley by it is lifted. Person gets on 'the platform is lifted when he/she switch on the plug the motor starts, after that the shaft of motor is connected to gearbox (speed reducer) by the Oldham's coupling. The outlet shaft of gearbox is connected to another Oldham's coupling which transmits the power to the spindle to wind or unwind the rope. Winding the rope will lift the platform up & unwinding will make the platform go down. There are advancements in very fields like software technology, more safety feature, and manually operated,

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etc. They want to develop country; they must have to use stair lift which should be affordable and easily operated in our Homes, Hospitals, Apartments, Old —Age Homes, etc. Hence, they found the best way for climbing stairs through the stair lifts which is more beneficial for Old age or Handicapped people in their life. This Design of stairs with escalators (stair lift) enables the easier transporting and handling of person or a object in various places with very low price and low maintenance and can be fixed on any type of stairs. While in design if the platform is replaced by seat more comfort and safety is possible and can be used is instead of lifts in small houses. [2]

Will Y. Lin, done the work on, Article- Automatic Generation of High-Accuracy Stair Paths for Straight, Spiral, and Winder Stairs Using IFC-Based Models, according to his study, The indoor space model is the foundation of most indoor location-based services (LBS). A complete indoor space model includes floor-level paths and non- level paths. The latter includes passages connecting dierect floors or elevations such as stairs, elevators, escalators, and ramps. Most related studies have merely discussed the modeling and generation of floor-level paths, while those considering non-level paths usually simplify the formation and generation of non-level paths, especially stairs, which play an important role in emergency evacuation and response. Although the algorithm proposed by i-GIT approach, which considers both floor-level and non level paths, can automatically generate paths of straight stairs, it is not applicable to the spiral stairs and winder stairs that are common in town houses and other public buildings. This study proposes a novel approach to generate high-accuracy stair paths that can support straight, spiral, and winder stairs. To implement and verify the proposed algorithm, 54 straight and spiral stairs provided by Autodesk Revit' social website and three self-built winder stairs are used as test cases. The test results show that the algorithm can successfully produce the stair paths of most test cases (49/50), which comprehensively extend the applicability of the proposed algorithm. [3]

Sumedh Ingle, Anshul Gupta, Rohit Chauhan, Kamlesh Naik. done the work on, Design and Fabrication of Mechanized Stair, according to his study, generally at many places there is no provision for disable people to climb the stairs with the help of this mechanized stairs the person will able to do it. The objective is to transmute the staircase into ramp or platform, so that lame or disable people can make use of it. It is an amalgamation of stairs and ramp so it can use alternately whenever needed, it is a type of portative stairs. Involvement of such mechanized things will help to reduce human work. The main rationale behind working on this topic is to reduce human effort in day-to-day life and vanquish the difficulties. The work is done to bring the conceptual idea into reality. Experience through recent studies reveals that ramp and stairs are used separately; by introducing mechanized stairs it can be used with ease, and it is practically beneficial. Various other mechanisms can also implement for the same process, it can be automated by using electric motors for giving motion to worm rod. By using different materials strength, load bearing capacity, resistant to weather can be improve. Sensor and alarms can be installed for safety purpose. [4]

K.Navya, B.Pavan Kumar, G.Hema Mounika, B.Vineeth, K Prabhakara Rao, 1 A Pasha, done the work on, Smart Stair Lift for Disabled and Elderly, according to his study, The main objective of this project is to develop an indoor as well as outdoor stair lift. A stair lift is a chair that glides up and down a staircase on a motorized rail. While going up and down the stairs safety is the primary concern, the present-day, top-quality lifts include many features to maximize comfort, ease of use and attractiveness in the home, which is a safe and affordable solution to overcome the unique needs and challenges that people experience on the stairs. Stair lift, the mobile chair-like mobility device attached on one side of stairways, allows to improve access for aged between floors at homes, and to make many people with mobility problems live independently through the internet of things. Hence, we are designing a single rail stair elevator to reduce production costs as well as construction time that is required in case of escalators and elevators. In this paper, they proposed an IOT based system, which provides the easy way for aged and physically handicapped for mobility over stairs. After getting phone connected to the system, easily using the application which is on your phone one can ascend or descend over the stairs. In the automatic mode, smart positioning of the sensor enables sliding over the stairs even easier with least efforts made by human. Architecture is cost effective and portable with in less time This system can be advanced to have a battery back in case of any power issues. This system can be implemented on straight stairs only and can be further modified for even turns. [5]

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III. METHODOLOGY

Sequence of proposed methodology is as follows —

Step 1 - Basic Information & Literature survey about Convertible Stair Case.

This project report discusses about how to use literature data & identify the problems from field. By studying the literature of previously available system that help in maximizing the output by minimizing the effort, cost, time & money in future develop new machine.

Step 2 - Selection of Components for Convertible Stair Case.

This project work will first introduce the background of the study. Presents the design constraints that influence on the use, efficiency & benefits their impacts on machine. After that machine parts design all different existing machine assembly units will be done to make a probable machine model.

Step 3 - Design of Convertible Stair Case system.

This project work will start to manufacture after purchasing of required specification material & making sample simulations which will be easy for visualization. After that manufacturing procedure of machine will be done, after this cost estimation of machine will calculate.

Step 4 - CAD modeling & Fabrication of Convertible Stair Case system.

At this step CAD model of project done and fabrication will start.

Step 5 -Assembly & Testing of Convertible Stair Case system.

Finally, after complete manufacturing procedure, will test the working model which will satisfy probable objectives or not. After that complete working & satisfied testing will discuss advantages & applications of the machine while performing satisfied operation with complete report writing.

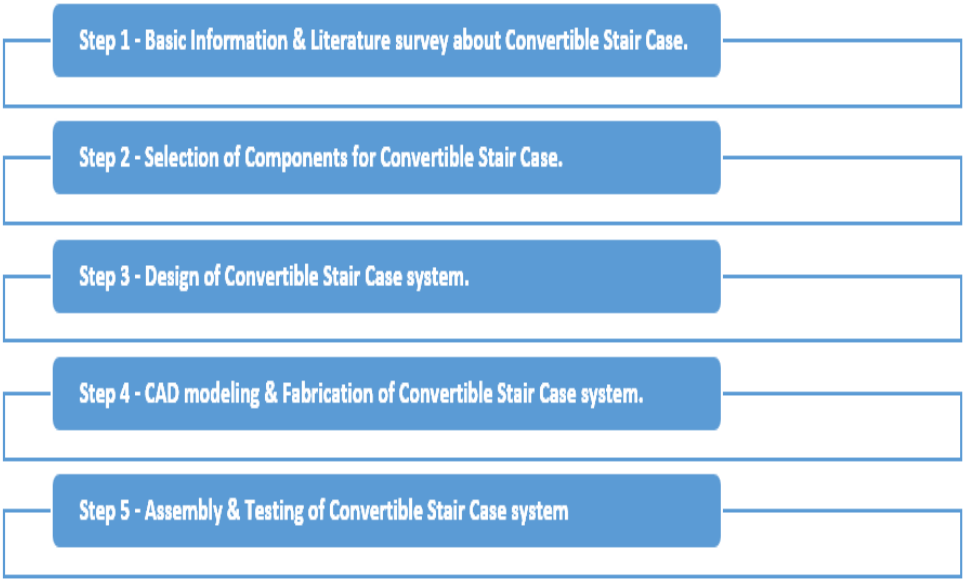

Figure 1. Methodology.

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Figure 2. Actual Working Model of Convertible Staircase to Ramp Project.

IV. WORKING AND FABRICATION OF PROJECT

The main concept of convertible stairs to ramps system is creating a combination of stair and ramp by implementing mechanical linkages, different mechanism & pneumatic components. So that it can be use simultaneously as a stair or ramp as per use or need. As per contemplate there is a major predicament for disable people for climbing stairs so this idea was conceptualized by integrating with pneumatic systems. By considering the concept, the fabrication was carried out to prepare the stairs by fulfilling three basic requirements economic viability, technical feasibility and social acceptance. It consists of main body which is a right-angle triangle support structure which holds and supports all the parts. All the load of the body and element is sustained by adjustable stand. Motion to the treads is provided with the help of pneumatic & mechanical linkages structure, which are mounted over the frame. When we apply switch to ON the solenoid valve, the air passes to double acting cylinder which motion is directly translated to the motion of the 'treads. Stairs are totally based on pneumatic mechanism which provide up and slant motion to the tread. In general condition it can be used as normal stairs, when cylinder forward motion is provided to the linkages and the same motion is gained by the stairs which is meshed with the ramp structure. On converting into stairs, it is provided with the self-locking system with the help of pneumatics.

V. ADVANTAGES

1) An automatic convertible staircase to ramp control is implemented with very simple hardware and easy control. 2) Human Intervention while automatic convertible staircase to ramp can be easy which reduce accidents of physically disable & old edge people.

3) It will give better comfort of traveling over stairs as compared to another type of staircase systems. This system has higher safety as compared to others staircase in safety point of view.

4)There are very rare chances of an accident during down the staircase or ramp.

VI. APPLICATIONS

1.Public Buildings Hospitals, clinics, and health centres: Enables smooth wheelchair access and safe stair use in shared entryways. Municipal offices, banks, and post offices: Improves accessibility without needing separate structures. Railway stations or bus terminals: Assists both pedestrians and wheelchair users with level changes.

2. Educational Institutions Schools, colleges, and universities: Aids mobility-impaired students and staff in moving between floors or platforms. Can be installed in libraries, stages, or auditoriums to ensure inclusivity.

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3. Residential Homes Especially beneficial in homes with elderly residents or people with disabilities. Perfect for duplex houses, raised entrances, or garden decks. Keeps home design compact and clutter-free.
4. Commercial Spaces Shops, malls, and restaurants: Enhances customer accessibility where space is limited. Allows quick switching between ramp and stair based on crowd dynamics.
5. Hotels and Lodging Used in entrance lobbies and connecting corridors to accommodate all guests. Supports inclusive design without compromising on aesthetics.

VII. CONCLUSION

It is concluded that the proposed concept is most useful for disable peoples in all sector. We can change the design as per our need using same concept. The concept is simple and innovative in nature.

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