

Enhancing Vertical Mobility: A Stair-Climbing Trolley Study

B Kiran Kumar¹,

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Andhra Pradesh 522302, India

B Likith Sai Kumar²,

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Andhra Pradesh 522302, India

P Jaswanth³,

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Andhra Pradesh 522302, India

K Shivadeep Sai⁴,

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Andhra Pradesh 522302, India

V Ram Gopal⁵,

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Andhra Pradesh 522302, India

K Prasanth Kumar Reddy⁶

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Andhra Pradesh 522302, India

Email Id: buragaddakirankumar15@gmail.com

Abstract:

In the modern household, the need for practical and efficient solutions for everyday tasks is ever-present. The household stair climbing trolley is a transformative innovation designed to address the challenges of moving heavy items within homes, offering an ingenious alternative to traditional methods. The household stair climbing trolley is a specialized device tailored for domestic use, specifically engineered to navigate stairs, uneven surfaces, and tight spaces with remarkable ease. This unique mechanism minimizes the physical effort required to transport heavy objects up and down stairs, significantly reducing the risk of strain and injury to people. Safety is paramount within the home, and the stair climbing trolley contributes to maintaining

a secure environment. By alleviating the physical burden of lifting and carrying heavy objects, it minimizes the potential for back injuries and accidents. This not only enhances the well-being of individuals but also ensures a safer and more comfortable living space. Furthermore, the household stair climbing trolley streamlines household operations, making everyday tasks more efficient. Whether it's transferring an LPG cylinder, carrying a water can, or carrying a rice bag, this trolley's capacity to handle stairs and obstacles simplifies household chores, ultimately saving time and energy. In conclusion, the household stair climbing trolley is a groundbreaking addition to domestic living, providing an innovative solution for moving heavy items within homes. Its adaptability, safety features, and efficiency benefits make it an indispensable tool.

Keywords: Stair climbing trolley, injuries and accidents, streamlines household operations.

Introduction

In our modern, urbanized world, where individuals and families reside in multi-story buildings, the necessity of moving heavy objects up and down stairs is a common daily challenge. Traditional methods of carrying such items often involve significant physical effort and can lead to injuries and accidents. In this context, the household stair climbing trolley has emerged as a pioneering solution to address these challenges. This research paper aims to provide a comprehensive analysis of the stair climbing trolley, exploring its design, functionality, safety features, and the potential impact it can have on improving the quality of life in households.

Literature Survey

Johnson, Kyle A., et al. [1] Explaining Tumbling Mode Tumbling Mode offers a powered way to keep a robot moving when it encounters more unstable barriers (stairs, rubble, loose soil, etc.). When the Tri-Wheel assembly is in Tumbling Mode, a braking mechanism is activated to apply force to the gearing system, forcing the three wheels to revolve around the middle axle and navigate obstacles like a Whigs robot. To aid with the robot's propulsion, the trispoke rotation purposefully rotates in the same direction as each individual wheel. Depending on the situation, the Tumbling Mode mechanism can be used passively, by an operator order, or automatically based on input from sensors that detect stalling, possible slippage, or a specific

distance from the barrier that needs to be overcome. This vehicle uses a tiny drum brake with a cam that is activated by an operator's order for stopping. Three Wheels in Tumbling Mode going up steps. Owing to its unique rolling and climbing capabilities, the Tri-Wheel rolls along a step surface until it reaches a suitable angle to roll over itself again and resume its climbing motion. It does this by rotating around its central axle when approaching a step.

Md. A. Hossain, et. al [2] has deduced that in the original design, every wheel had three planetary wheels, a sun wheel, and a frame. By use of an idler, the solar wheel and the planetary wheel were linked. To revolve the planetary wheels in the same direction as the sun wheel was the aim of the idler. With the idler and sun wheel in a straight line, each planetary wheel was positioned. To tilt the wheel frame and engage the next planetary wheel, a straight wheel frame requires greater energy. Due of each arm's excessive length, the car would vibrate and become unstable. In the current design, the wheel frame is curved to prevent the arm's front surface from colliding with the stair's edge. Olodu et al., [3] have concluded that the stair-climbing hand truck is designed to reduce liability rather than increase it. Conventional hand trucks work well on flat ground, but their usefulness decreases when it becomes necessary to move an object over an irregular surface. Package deliverymen, for example, often find it necessary to drag loaded hand trucks up short flights of stairs just to reach the front door of a building. The entire purpose of using a conventional hand truck is to avoid having to lift and carry heavy objects around. [10] Mr. Ravi R. Mishra: Modified In the first design, the height of the steps provides a significant hurdle in the route of the vehicle, making the power transfer to the single or double wheel trolley worthless for climbing the stairs. In addition, the straight wheel frame's design got more intricate and need to be adjusted with a curved, spherical shape in order to provide the right drive, which increased frictional force. To offer smooth power transfer and enable obstacle-free stair climbing, three wheel sets were added to each side of the vehicle and secured to the frame. The frame structure works well for transmitting precise velocity ratios as well. It offered dependable service, a small architecture, and increased efficiency. Norain et al., [4] In the modern world though there are many developments in the field of engineering. Still there are difficulties to carry heavy loads over stairs. While the development of lifts has made it easier to move large objects upstairs, not all locations, such as schools and colleges with construction zones, can accommodate lift use. The goal of this project is to create

a system that will make moving big objects upstairs simple. These are necessary because of the daily demands on our society. Hand trolleys are among the tools used to lessen the strain of lifting on level ground. However, these devices usually fail when it comes to carrying the load over short flight of stairs. Our project attempts to design a stair climbing trolley which can carry heavy objects up the stairs with less effort compared to carrying them manually. The main objective of the project is to find an efficient and user friendly method of carrying various objects through stairs using minimum effort from the user and to also provide a smooth movement while climbing the stair. A stair climber with tri-lobed wheel frames on both sides has been produced as part of this project. In the tri lobed frame, three wheels are employed on each side of the climber. With the help of a pinion gear mesh to slow down the wheel's rotational speed and a DC gear motor to supply the required rotational power, the gear-motor mechanism turns the wheel assembly. A DPDT switch is linked to the motor via a lead acid battery with a comparable rating.

Background

3.1 Traditional Methods vs Stair Climbing Trolley

Moving heavy objects within a household, especially when stairs are involved, has historically relied on manual labour and physical strength. Common tasks like transferring LPG cylinders, carrying water cans, or moving heavy groceries can be strenuous and pose a risk of injuries, particularly to the back and shoulders. Traditional methods also tend to be time-consuming and inefficient, often requiring multiple trips up and down the stairs. The stair climbing trolley revolutionizes this process by providing a specialized device that is designed to navigate stairs, uneven surfaces, and tight spaces with remarkable ease. It minimizes the physical effort required, significantly reducing the risk of strain and injury, making it an ideal tool for enhancing the well-being of individuals.

3.2 Safety in the Home

Safety within the home is of paramount importance. The risk of injuries due to lifting and carrying heavy objects is a concern for many households. Back injuries, in particular, can have long-lasting and detrimental effects on an individual's health and quality of life. The stair climbing trolley plays a significant role in maintaining a secure environment by minimizing the potential for such injuries.

1. Design and Functionality

The stair climbing trolley is engineered with a unique and innovative design to address the challenges of moving heavy items within a household setting. Its key features include:

4.1 Tri-Wheel Mechanism

The trolley is equipped with a tri-wheel mechanism that allows it to climb stairs effortlessly. This mechanism ensures that the trolley can navigate each step smoothly, significantly reducing the amount of effort necessary to move heavy object up and down stairs.

4.2 Ergonomic Handle

The trolley features an ergonomic handle that provides a comfortable grip, reducing strain on the operator's hands and wrists. This handle can be adjusted to suit the height of the user, making it user-friendly for individuals of different statures [5].

4.3 Foldable Design

Many stair climbing trolleys come with a foldable design, allowing for easy storage when not in use. This feature ensures that the trolley does not occupy excessive space in the household.

Figure.1 depicts the cart's design, highlighting its key components. The primary element, denoted as part no. 2, serves as the load-carrying base where the object will be positioned. To enhance stability, part no. 6, known as the load support, has been incorporated to prevent any backward slipping of the load. When dealing with hefty loads, it is advisable to employ ropes to secure the loads to both the load support and the frame beneath the handle. The stair climbing cart's dimensions are illustrated in Figure.2 below [6]. The cart's mainframe is crafted using structural members, connected through welding following precise cutting and edge preparation. These cost-effective members streamline the manufacturing process, minimizing steps and operator involvement[7]. Additionally, the welded joints on structural members decrease the need for extra machinery and reduce operator costs.

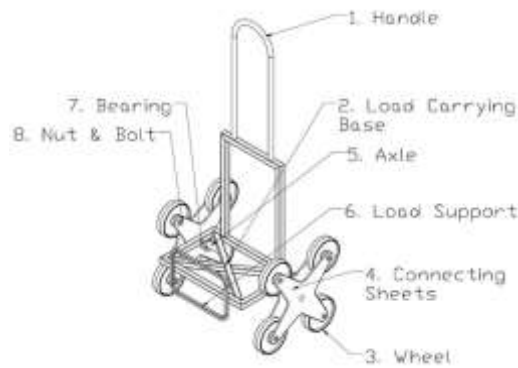


Figure.1 Main Parts of the stair climbing cart

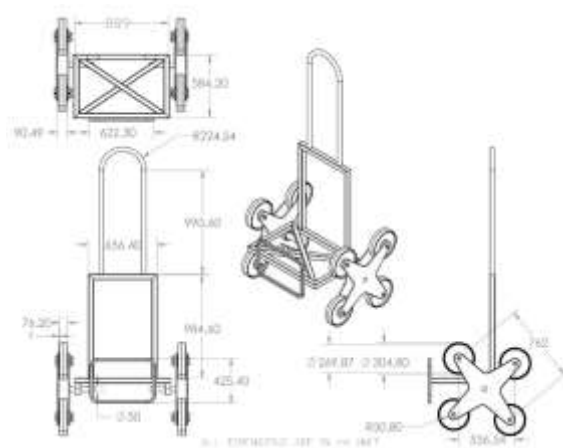


Figure.2 Dimensions of the stair climbing cart

2. Safety Features

Safety is a central consideration in the design of the stair climbing trolley. Several safety elements and features are included to reduce potential risks:

5.1 Anti-Skid Wheels

The trolley's wheels are designed to prevent slipping, even on wet or uneven surfaces[8]. This feature enhances stability and reduces the likelihood of accidents.

5.2 Adjustable Straps

To secure heavy objects in place, stair climbing trolleys often include adjustable straps or belts. These straps prevent items from shifting during transport, reducing the risk of items falling and causing injury [9].

5.3 Load Capacity Limits

Each stair climbing trolley has a specified load capacity limit. Users are encouraged to adhere to these limits to ensure safety[10]. Overloading the trolley can result in instability and accidents.



Figure.3 Rubber grippers at bottom of the stair climb

The stair Climbing cart allows you to safely move heavy loads up and down staircases. No matter the size, weight or shape of the item, the stair climbing robot will do the heavy lifting for you. Able to travel over any surface, this stair climber can be used outdoors, indoors and on uneven surfaces – grass, dirt, gravel (See Figure.3).

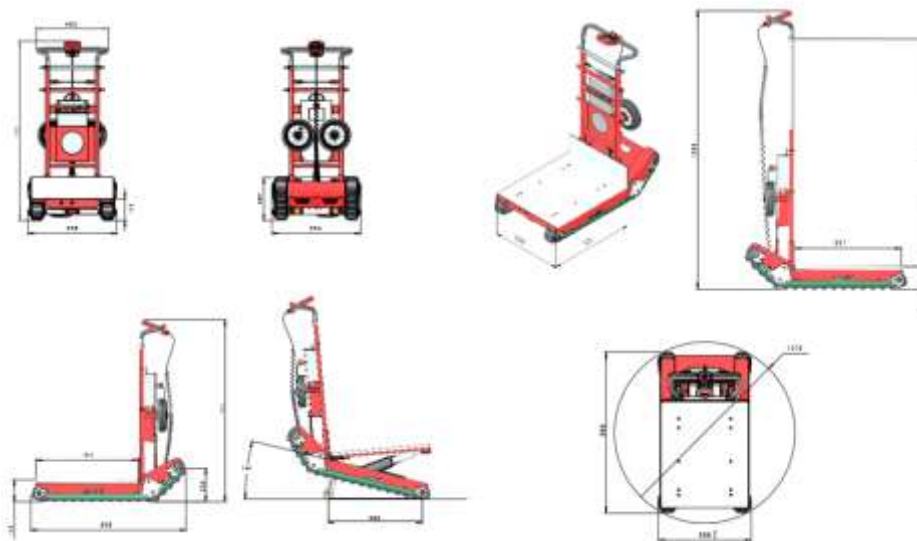


Figure.4 Specification of a stair climbing robot [11]

Crawler tracks through cutting-edge molding techniques, tracked stair climbing trolleys, merging accumulated experience, know-how, and valuable customer input to forge what could be deemed the finest tracks ever created [12]. Navigate nearly any terrain with a stair climbing

trolley, whether it's the gentle touch required for marble or parquet surfaces or the rugged landscapes of construction sites or the outdoors.

The stair climbing cart come with various capacities, including 160, 300, and 400 Kg. The weight of the stair climbing cart. The structure is adjustable in height, and the vertical structure is detachable from the crawler track chassis (see Figure.4). Using the proportionate joystick, one may vary the speed at which stairs are travelled according to their capacity. The type of battery used is 24V 20Ah, and the battery life varies based on the load capacity. The manoeuvring space on the landing is 109 cm, and the degree of protection is IP54. Standard equipment includes a fixing strap, battery charger, and a standard base. Keep in mind that the provided battery autonomy values are indicative and depend on factors such as recharging cycles, battery usage, storage temperature, and condition [11].

3. Efficiency Benefits

The household stair climbing trolley offers several efficiency benefits:

6.1 Time Savings

By simplifying the process of moving heavy items, the trolley saves time and effort. Users can complete tasks more quickly and efficiently, allowing for more time to focus on other activities [13,14].

6.2. Energy Savings

Traditional methods of moving heavy objects can be physically exhausting. The trolley's design significantly reduces the physical effort required, conserving the user's energy for other tasks.

6.3. Streamlined Household Operations

The trolley's adaptability and efficiency make it an indispensable tool for various household chores. It simplifies tasks such as transferring LPG cylinders, carrying water cans, or moving heavy groceries, making daily life more manageable.

Conclusion

The household stair climbing trolley is a groundbreaking addition to domestic living, providing an innovative solution for moving heavy items within homes. Its unique design, tri-wheel mechanism, ergonomic handle, and safety features make it an indispensable tool for households looking to improve the quality of life, enhance safety, and streamline everyday

tasks. By alleviating the physical burden of lifting and carrying heavy objects, it minimizes the potential for back injuries and accidents, contributing to a safer and more comfortable living space. As households continue to adapt to modern living in multi-story buildings, the stair climbing trolley emerges as a vital tool in maintaining efficiency and safety. Its adaptability and efficiency benefits make it an indispensable addition to the modern household.

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