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A STUDY ON EXPLORING THE VERSATILITY AND EFFICIENCY OF MULTIPURPOSE TROLLEYS: A COMPREHENSIVE RESEARCH STUDY

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ABSTRACT
This paper presents research and analysis on multipurpose trolleys. Hand trolleys are commonly used to transport heavy loads within industries. However, transferring loads from one floor to another, especially when stairs are involved, presents challenges. Traditional trolleys are not designed for stair navigation. This paper investigates the design considerations and material selection necessary to develop a robust and user-friendly trolley capable of navigating stairs. As urban populations burgeon and environmental concerns intensify, the necessity for sustainable urban transportation solutions becomes increasingly paramount. This paper presents a comprehensive examination of one such solution, termed "Trolly." Trolly embodies a novel approach to urban mobility, amalgamating elements of tramway and trolleybus systems with modern technological advancements and sustainability principles.
Through an interdisciplinary lens, this study delves into the historical evolution, operational mechanics, and environmental implications of trolley systems. Drawing from urban planning, transportation engineering, and environmental sustainability literature, a multifaceted framework for designing and implementing Trolly networks is formulated. Key considerations encompass route optimization, infrastructure development, energy efficiency, and socioeconomic impacts.
Moreover, leveraging contemporary innovations such as regenerative braking, smart grid integration, and autonomous capabilities, Trolly emerges as a dynamic and adaptable solution poised to address the complex challenges of urban transportation in the 21st century. Case studies from pioneering cities worldwide underscore the efficacy and versatility of Trolly systems across diverse urban landscapes.

KEYWORDS:
Trolley, Multipurpose, Stairs, Urbanization, Design, Material Selection

INTRODUCTION
The increasing demand for efficient goods and services due to urbanization underscores the need for innovative solutions. Conventional hand trolleys, with two wheels, are primarily designed for flat surfaces. However, they are inadequate for navigating stairs. This research focuses on designing a multipurpose trolley with three wheels, enabling it to traverse stairs efficiently. This trolley finds applications in various sectors, including civil construction, libraries, railway stations, airports, malls, and households. The objective is to alleviate the physical strain associated with transporting heavy loads, especially for individuals such as labor workers. Urbanization continues to surge globally, posing multifaceted challenges for transportation systems in densely populated areas. As cities expand, the need for sustainable, efficient, and adaptable urban mobility solutions becomes increasingly pressing. In response to this imperative, the concept of the Multipurpose Trolly emerges as a promising avenue for addressing diverse transportation needs while prioritizing environmental sustainability, social equity, and economic viability.
The Multipurpose Trolly represents a fusion of traditional trolley systems with innovative design principles, technological advancements, and a multipurpose functionality tailored to meet the evolving demands of modern urban environments. Unlike conventional public transport modes that often serve

a singular purpose, such as tramways or trolleybuses, the Multipurpose Trolly is envisioned as a versatile platform capable of accommodating various transport needs within urban settings.

LITERATURE REVIEW

Bhavin J Shah, Virag A Timbadia, Rahul Bhat, Dhruvi N Panchal, Karan Dave (2018) [1] in his study on "Development of Multi-Purpose Trolley" The trolley has been successfully designed and fabricated. Functioning of the same has been confirmed by loading conditions and found working as per requirements. The re-modification was done on the basis of feedback received from end users. Single design can be used for both applications i.e. shopping mall and airport. Effort required to move the trolley is very less as the self-weight of trolley reduced. The structure is robust and rigid. Smooth in operation and can carry enough amount of load. PU wheels reduces the noise, its corrosion resistance is also high. It can be move over almost any kind of surface very easily. Maintenance is easy. The same working model of trolley is being developed with more creative modifications in future as per the required market conditions.

Virag A Timbadia,Rajendra S Khavekar, Dr.K N Vijayakumar (2017) [2] in their study on "Design and Development of a Multi-Purpose Trolley"

The trolley has been successfully designed and fabricated.

Functioning of the same has been confirmed by loading Conditions and found working as per requirements. Automation of wheel has been developed successfully and tested to reduce the human effort at the handle of the trolley for giving appropriate direction. The same working model of trolley is being developed with more creative modifications in future as per the required market condition.

Al Sult Al Kharusi, Dinesh Keloth kaithari, Muhammad Mumtaz Mirza, Parimal S. Bhambare(2018)[3] in their research paper "Electrically Operated Multipurpose Trolley" An Automatic trolley with all dimensional constraint is designed. The 3D model of the trolley is designed in the sharp 3D Software with isometric view generated. Stress analysis on the trolley structure and sliding platform is done by using Creo V3 software. The individual drive motors for the rear wheels enable the forward movement, backward movement as well as clockwise and anticlockwise rotation Therefore, the time period required for movement during transportation is less as compared with conventional trolley. The time required to travel 10 m of distance on a horizontal floor for full speed and maximum load condition is 7 seconds whereas the time required to travel 10 m of distance on a horizontal floor with half speed and full load condition is 9.6 seconds. Various drawbacks which were present in the conventional trolleys such as excessive human labor and more time involvement were reduced. Photovoltaic cells used for charging the power bank which in turn charge smart devices. Moreover heavy weights can be easily loaded with sliding platform and the weights can be directly measured using digital weighing scale available on the trolley. Handle of the trolley can be easily folded which makes it enable to be transported easily from one place to another. Also, front wheels are free in movements which get advantage to drive the trolley manually in case if there is no power to charge battery. The trolley was done using mild steel material for the purpose of demonstrating which is strong and cheap. However, aluminium material which is more expensive and lighter can be used for the purpose of manufacturing. Aluminium is chosen because of the less density and anti-corrosive property as well. Another possible way of extension is accommodating the driver on the trolley itself and run the trolley just by controlling the joystick. Electrical power generation during running of trolley can be a future work in order to save energy. To upgrade the airport facilities, airport information like airline times, get their boarding pass tickets through the trolley itself as well as guide the passenger to the airplane gate that make traveling easier and comfortable.

A F Milania and A D Prabaswari (2020)[4] in their paper "Multifunction Trolley Based on Anthropometry for UD. Santosa to Minimize the Physical Workload That Caused by Material Manual Handling" The recommended limit weight load by each worker in UD. Santosa is different. The RWL for operator 1-5 is sequential as follows 98.60549; 154.2396; 14.23046; 17.30394; 18.80908. The RWLs have an impact on the lifting index, the higher the RWL the lower the lifting index. It means that the operator that has a low lifting index or less than 1.0, has a low risk of musculoskeletal disorder

or injury. The workers' physical workload from operator 1-5 is sequential as follows classified into the need to be improved, no fatigue, need to be improved, no fatigue, and need to be improved. The dominant one needs to be improved. So, it needs further investigation. The problem faced by the workers in making them having physical workload is the long hours of working, flexible resting time, and no clear job description. The anthropometry applied to the design of the supporting tools so it fits the workers. The body dimension that is used on the design is high handgrip, shoulder height standing, elbow height standing, and the palm width.

SIGNIFICANCE

The significance of this research lies in its potential to improve the efficiency and safety of load transportation, particularly in urban settings. By addressing the limitations of traditional trolleys and introducing features tailored to navigating stairs, this multipurpose trolley offers practical benefits to users, especially Hamal workers.

OBJECTIVE

The primary objective of this project is to design and produce a multipurpose trolley equipped with additional features that facilitate the movement of heavy loads on stairs. By enhancing usability and addressing specific user needs, this trolley aims to improve the efficiency and comfort of load transportation, particularly in urban environments.

MATERIALS AND METHODOLOGY

The materials used in this invention include rubber bushes, silicone wheels, aluminum angles, and handles. Key metrics such as load capacity, stability, and energy efficiency are evaluated to compare the proposed trolley with existing solutions. Practical usability and market potential are also assessed**.**

PRODUCT SPECIFICATIONS

- **Materials Used:** Rubber bushes, silicone wheels, aluminum angles, handles

Design Considerations

1. **Stability:** The trolley must maintain stability while traversing stairs to prevent accidents and ensure the safety of both the user and the transported goods**.**
2. **Maneuverability**: The trolley should be easy to maneuver, allowing the user to navigate through tight spaces and corners with minimal effort.
3. **Load Capacity:** The trolley must be capable of carrying heavy loads without compromising its structural integrity or performance**.**
4. **Ergonomics:** Ergonomic features such as handle design and height adjustment should be incorporated to minimize strain on the user's body during operation**.**
5. **Material Selection:** High-quality materials that are durable, lightweight, and resistant to corrosion should be chosen to ensure the longevity and reliability of the trolley**.**

Features

1. Triangular Wheel Configuration: The trolley is equipped with three wheels arranged in a triangular configuration to facilitate smooth movement on both flat surfaces and stairs. This design ensures stability and balance during ascent and descent.

2. Rubber Bushes: Rubber bushes are used to absorb shocks and vibrations, enhancing the trolley's stability and providing a smooth ride for the transported goods.

3. Silicone Wheels: Silicone wheels offer excellent grip and traction on various surfaces, including stairs, reducing the risk of slippage and improving overall safety.

4. Aluminum Frame: The frame of the trolley is constructed from lightweight yet sturdy aluminum, providing strength and durability while keeping the overall weight of the trolley low.

5. Adjustable Handle: The handle of the trolley is adjustable in height to accommodate users of different heights and ergonomic preferences. It is designed with comfortable grips to minimize hand fatigue during prolonged use.

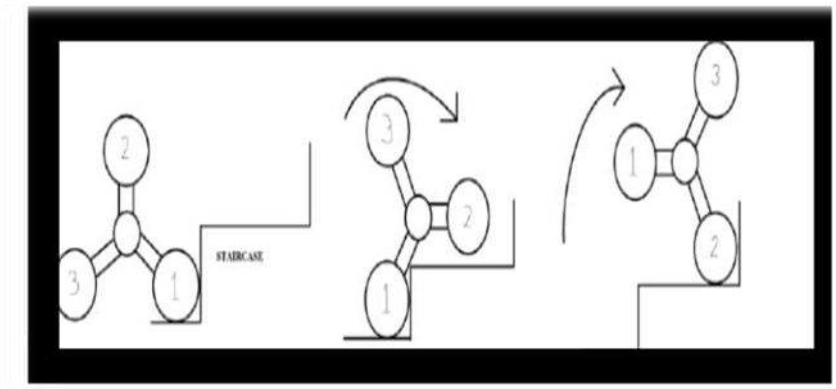


Figure-1: Diagrammatic representation of proposed model

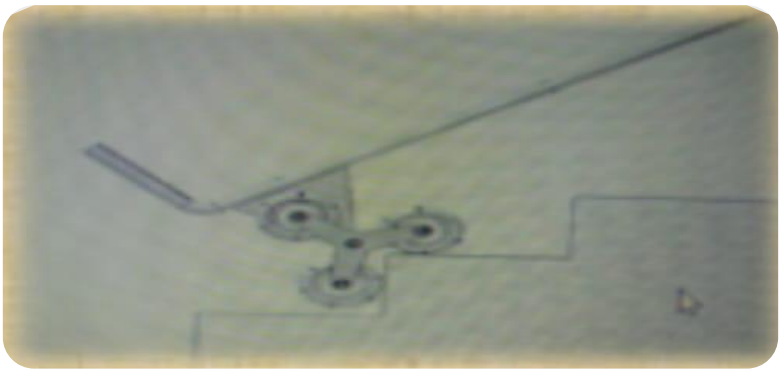
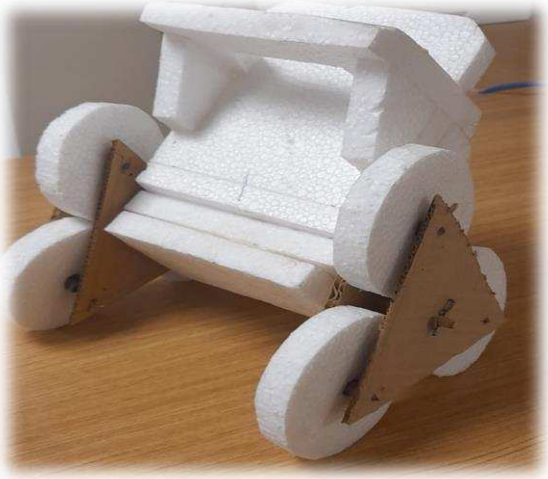


Figure-2: Diagrammatic representation of proposed model



Photograph-1: Model Prototype: Left side front view
Photograph-2: Model Prototype: Right side front view

Photograph-3: Model Prototype: Left side view

CONCLUSION

In conclusion, this research paper highlights the significance of design optimization in enhancing the performance of multipurpose trolleys, particularly for navigating stairs. By addressing specific user needs and leveraging innovative design features, the proposed trolley offers a practical solution for urban goods and services transportation. Future research directions and potential applications are also discussed, emphasizing the importance of continuous innovation in this field.

FUTURE SCOPE FOR RESEARCH

Future research can explore advanced materials and technologies to further improve the efficiency, durability, and usability of multipurpose trolleys. Additionally, research on ergonomic design principles and user-centric features can enhance the comfort and safety of trolley operations.

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