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Multi-purpose EV for Physically Challenged People and Old Age: A Survey

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Abstract - This survey paper explores the transformative potential of a multi-purpose, three-wheeled electric vehicle (EV) in revolutionizing local mobility, particularly for local vendors and individuals with physical disabilities. Central to this innovation is the incorporation of dual batteries with solar charging capabilities, which provide sustainable power solutions. Additionally, the vehicle is equipped with cutting-edge antitheft security systems and a compact trolley for versatile use. A ground-breaking feature of this EV is the rotating seat, designed with anthropometry principles to ensure optimal comfort and accessibility for all users.

The vehicle's advanced AR-based maintenance applications facilitate easy upkeep and battery health monitoring, reflecting a strong commitment to user-centric innovation. The trolley, enhanced by a scissors jack lifting system powered by a linear actuator, can handle loads of up to 350 kg. This feature simplifies the storage and handling of goods, specifically aiding physically challenged and elderly users. The emphasis on practical, inclusive solutions is a key theme throughout the paper.

Furthermore, the technical superiority of essential components, including the Motor Controller, Motor, Solar Controller, Battery, and Throttle, ensures enhanced operational efficiency. By examining the mobility challenges faced by individuals with disabilities, the paper underscores the societal importance of inclusive transportation solutions.

This research lays the groundwork for future advancements, such as the integration of electric, solar, and hydrogen cell engines, underscoring a forward-looking approach to sustainable and transformative mobility solutions. The envisioned innovations carry the promise of substantial societal impact, paving the way for a more inclusive and sustainable future in local transportation. This comprehensive survey highlights the potential of these technological advancements to profoundly reshape the mobility landscape for various community segments.

Keywords- Multi-purpose Electric Vehicle, Three-Wheeler EV, Accessibility, Inclusivity, Solar Charging, Anthropometry, Anti-theft Security, Battery Health Monitoring, AR-based Maintenance, Market Potential, Sustainable Technology, Automation.

I. INTRODUCTION

Ensuring mobility for local vendors and people with disabilities is vital for a truly inclusive society. Traditional transportation options often fall short in meeting their unique needs, hindering their independence and participation. This research paper introduces a groundbreaking solution: the multi-purpose three-wheeler electric vehicle (EV).

This innovative EV boasts features like dual batteries with solar charging, anti-theft measures, and an

expandable trolley, redefining convenience and safety in local transportation. It also incorporates cutting-edge technologies like a rotating seat based on human body measurements, battery health monitoring, and AR-based maintenance, demonstrating a user-centric design approach.

By comprehensively examining the technical aspects, market potential, and future prospects of this EV, this paper aims to not only offer a solution to current mobility challenges but also lay the foundation for a more inclusive and sustainable transportation system. Through a combination of innovation, sustainability, and inclusivity, this research aims to transform local mobility and set a new benchmark for accessible transportation that caters to the diverse needs of all individuals.

The ultimate objective of this research is to illuminate the transformative power of the multi-purpose three-wheeler EV in addressing social inequalities related to mobility. By delving into its intricate design, technological advancements, and user-focused innovations, this paper aims to showcase how innovative solutions can lead to greater inclusivity and accessibility in transportation. Additionally, by analyzing the impact of such advancements on marginalized groups and individuals with disabilities, this study emphasizes the significance of creating a more equitable and empowering environment for everyone.

II. ARCHITECTURE

Three-wheeled electric vehicles (EVs) are gaining popularity as a sustainable transportation solution, especially in crowded cities. Unlike gasoline or diesel-powered vehicles, these EVs rely on battery-stored electricity for propulsion, making them environmentally friendly. They are well-suited for navigating tight spaces and congested roads due to their compact three-wheeled design.

The main components of a three-wheeler EV include:

Battery: A rechargeable lithium-ion battery pack stores the electrical energy needed to power the vehicle. The battery capacity directly influences the EV's range on a single charge.

Electric Motor: The motor converts electrical energy from the battery into mechanical energy, propelling the vehicle. The motor's power rating determines its acceleration and maximum speed.

Controller: This electronic component acts as the EV's control center, managing the flow of electricity from the battery to the motor. It regulates the vehicle's speed, torque, and overall performance, responding to driver input from the accelerator.

Regenerative Braking: Many three-wheeler EVs employ regenerative braking, where the motor functions as a generator during braking. This process converts kinetic energy back into electricity, recharging the battery and improving efficiency.

Charging System: EVs need to be connected to a charging station or power outlet to replenish their batteries. An onboard charger converts alternating current (AC) from the source into direct current (DC) for battery charging. Charging times vary depending on battery size and charging infrastructure.

Controls and Instrumentation: A control panel and instruments provide the driver with essential information like battery level, speed, and distance traveled. Standard automotive controls such as steering, brakes, lights, and turn signals ensure safe operation.

Three-wheeler EVs offer numerous benefits, including reduced operating costs, lower emissions, and quieter operation compared to traditional vehicles. Their simplicity, ease of maintenance, and suitability for congested urban environments make them an appealing option for short-distance travel. With continued technological advancements, these EVs are expected to contribute significantly to the future of sustainable urban mobility.

Building a three-wheeler EV involves combining various parts and materials to create a functional and reliable vehicle. Here's a breakdown of the key elements:

Chassis: Typically constructed from mild steel tubes, the chassis forms the backbone of the vehicle, supporting the battery, motor, seating, and other components. It features specific mounting points for the wheels, suspension, and body.

Wheels and Differential: Three-wheeler EVs use a differential mechanism on the rear wheels to enable smooth turning by allowing them to rotate at different speeds. The wheels are designed to withstand the vehicle's load and provide adequate traction.

Motor: Brushless DC motors are often preferred for their efficiency, compact size, and minimal maintenance requirements compared to brushed motors. These motors convert electrical energy stored in the battery into mechanical energy, driving the vehicle.

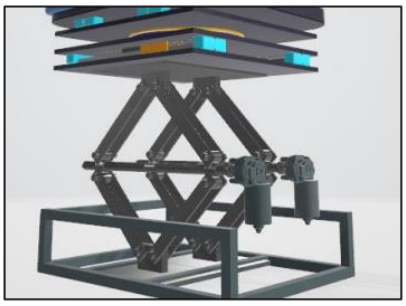
Electrical System: The electrical setup can differ across regions, with 48V systems common in India and 60V systems in Bangladesh. The system includes the battery, controller, wiring, and other electrical components responsible for power distribution and motor control.

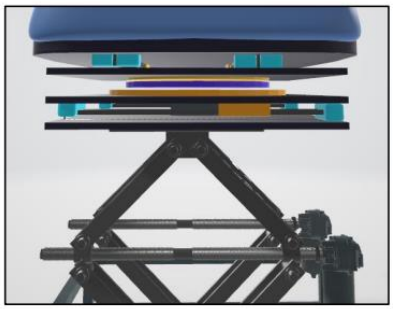
Body Design: Lightweight iron or aluminium sheets are commonly used for the body to minimize weight while maintaining structural integrity. Fiberglass bodies are also popular for their durability, reducing the need for frequent maintenance.

Batteries: Lithium-ion (Li-ion) prismatic batteries are a common choice due to their high energy density, long lifespan, and fast charging capabilities. They offer superior performance and longevity compared to older lead-acid batteries, making the vehicle more efficient and sustainable.

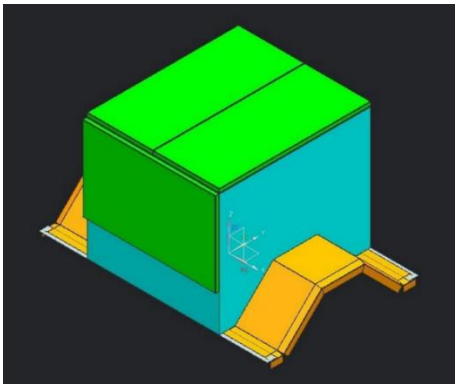
Seat Mechanism: The Seat Mechanism in the Electric Vehicle (EV) features a sophisticated integration of a jack mechanism, wiper motor, bearing mechanism, and a linear actuator to deliver a seamless and adaptive seating experience. Leveraging advanced engineering, the jack mechanism, equipped with a wiper motor, allows effortless automatic height adjustments at the push of a button, ensuring optimal comfort for users. Additionally, the incorporation of a bearing mechanism enables the seat to rotate smoothly by 180 degrees with automated locking at 0, 90, and 180 degrees, enhancing user convenience. Complementing this, the linear actuator extends the seat by 1.5 feet outward, facilitating effortless transitions for physically challenged individuals, thus promoting inclusivity and accessibility within the EV. The technical prowess of the integrated components is evident in their robust functionality, with the linear actuator efficiently facilitating controlled seat extension for enhanced accessibility. Simultaneously, the wiper motor exhibits precision in automated seat height adjustments, ensuring seamless and ergonomic positioning. These technical advancements, combined with thoughtful design, culminate in the Seat Mechanism's ability to cater to diverse user needs, exemplifying a harmonious blend of innovative

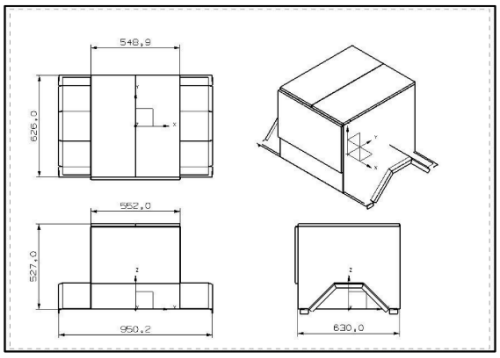
technology and inclusive design in the realm of electric vehicle seating solutions.

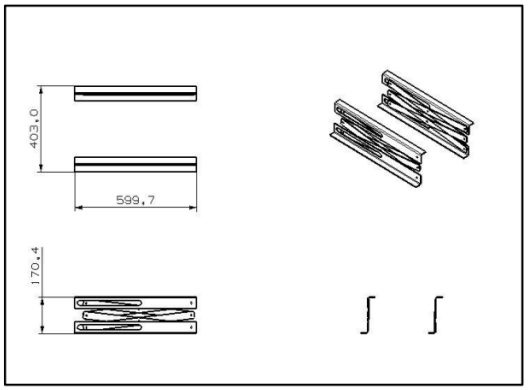




Trolley Mechanism: The Trolley Mechanism incorporated into the Electric Vehicle's rear storage space is engineered for seamless, user-friendly utility, featuring a robust scissors jack mechanism tailored for effortless loading and unloading of goods. This efficient lifting system operates with the help of a purpose-built linear actuator, capable of effortlessly elevating loads weighing up to 350 kg with a single button activation. Specifically designed to tackle the challenges faced by individuals with physical limitations and elderly users, this innovative mechanism provides them the independence to manage heavy loads without strain or effort, exemplifying a commitment to inclusivity and accessibility within the EV domain. The multi-functional nature of the trolley extends its utility beyond mere storage, offering a versatile solution for transporting goods and facilitating small businesses directly from the Electric Vehicle. Through its seamless integration, the trolley mechanism becomes an invaluable asset for users, serving as a compact, efficient, and user-centric solution with an emphasis on practicality and accessibility. With its thoughtful design and robust engineering, the trolley mechanism embodies a harmonious fusion of technological sophistication and inclusivity, redefining the paradigm of utility storage and transportation solutions within electric vehicles.







III. LITERATURE SURVEY

1. **Paper Name:** Design of Solar Tricycle for Handicapped Person

Techniques:
- Utilization of Solar PV Panel, Brushless PMDC Motor, Charge Controller, and Battery
- Literature review from various sources like journals, books, and articles

Application:
- Conversion of solar energy to electrical energy using solar cells
- Use of a brushless PMDC motor to convert electrical energy to mechanical energy for tricycle operation

Advanced Features:
- Designed for the comfort and ease of use for handicapped persons
- Environmentally friendly mode of transportation
- Focus on low speed, but longer distance usability

2. **Paper Name:** Design and Fabrication of a Motorized Tricycle for Physically Challenged Persons

Techniques:
- Customer need recognition through surveys
- Utilization of available local materials for design and fabrication
- Implementation of the Ackerman steering system

Application:
- Facilitation of transportation for physically challenged individuals
- Improvement on existing indigenous models

Advanced Features:
- Emphasis on simplicity in design, high performance, easy maintenance, and safety
- Components chosen for easy availability and reliability

3. **Paper Name:** Fabrication of Tri-Wheeled Electric Vehicle to Aid Disabled

Techniques:
- Selection and fabrication of chassis using hollow Mild Steel
- Mounting of wheels and hub motor, and attaching battery

Application:
- Internal transportation in hospitals and public places
- Use as an inspection vehicle in industries and campuses

Advanced Features:
- Lightweight design to reduce cost and weight
- Low height with better ground clearance for stability
- Catchy frame design with integrated accelerator and brake

4. **Paper Name:** AN IMPROVED & EFFICIENT ELECTRIC BICYCLE SYSTEM WITH THE POWER OF REAL-TIME INFORMATION SHARING

Techniques:
- Brushless DC motor and motor controller for efficient power management
- Regenerative braking system
- Photovoltaic solar panel as an alternative charging source

Application:
- Enhancement of a traditional bicycle into an electric one
- Real-time information sharing for efficient transportation

Advanced Features:
- Inclusion of throttle, horn, speedometer, and LED signals
- Charge controller for efficient battery management

5. **Paper Name:** Solar-Powered Tricycle Design

Techniques:
- Integration of solar energy conversion using solar panels
- Employment of a brushless DC motor for propulsion

Application:
- Use of renewable energy for transportation
- Efficient conversion and storage of solar energy

Advanced Features:
- Low-speed design for longer distances
- Focus on sustainability and practicality

6. **Paper Name:** Design and Fabrication of Reverse Gear Mechanism for Handicapped Person Vehicle
   Techniques:
- Gear and gearbox design specific to handicapped individuals' needs
- Use of moped vehicle components for easy adaptation

   Application:
- Enhanced mobility for physically disabled individuals
- Integration into moped vehicles without affecting performance

   Advanced Features:
- Simplified design for easy use
- Safety and comfort enhancements

7. **Paper Name:** Techno-Economic Investigation of Solar Powered Electric Auto-Rickshaw (SPEA)
   Techniques:
- Solar PV panels and MPPT controller
- BLDC electric motor and differential gears

   Application:
- Sustainable urban transportation
- Reduction of carbon footprint

   Advanced Features:
- Efficient power transmission using differential gears
- Off-vehicle solar concentrator with Fresnel lens for increased power output

8. **Paper Name:** Modification of Delta Tricycle
   Techniques:
- SOLIDWORKS design of parts
- Crank and lever mechanism for propulsion

   Application:
- Easier mobility for physically challenged individuals

   Advanced Features:
- Single slider steering mechanism
- Effort calculation for ease of movement

9. **Paper Name:** Development of Solar-Powered Tricycle for Handicapped People
   Techniques:
- Solar energy integration for power
- Lightweight design for better maneuverability

   Application:
- Sustainable and affordable transportation for handicapped individuals

   Advanced Features:
- Enhanced mobility and comfort
- Cost-effective and environmentally friendly

10. **Paper Name:** New Innovations in Automotive for the Physically Challenged People
    Techniques:
- Reverse gear mechanism design
- Solar tricycle development

    Application:
- Sustainable transportation for handicapped individuals
- Improved travel experience with enhanced safety features

    Advanced Features:
- Eco-friendly vehicles for reduced environmental impact
- Constant speed and enhanced mileage for longer travel distances

IV. LITERATURE SURVEY TABLE

Sr No.	Name of the paper	Authors	Publication Name	Published	Approaches
1	"Performance Analysis of a Solar Powered Wheel chair"	1. Algarni S 2. Mellouli S 3. Abhilash	Journal of Engineering Technology	October 2017	Integrates solar energy to convert to electrical energy using solar cells, contributing to an environmentally friendly mode of transportation
2	"Design and Development of Wheelchair Accessible Ramp for Scooters"	1. Madhusudhan T 2. Madhav P 3. Pranav S Meghlal 4. Rahul Ashok	IJIRSET	June 2017	Emphasis on simplicity in design, high performance, easy maintenance, and safety at a reasonable price
3	"A Review on Modern Hybrid Tricycle for Handicapped Person"	1. Jawale P R 2. Gabhane A R 3. Baje K G 4. Patil D N	International Journal of Research in Advent Technology	April 2017	Solar tricycle designed especially for handicapped persons, focusing on the comfort and ease of use
4	"Modification of Delta Tricycle"	1. Ravi Solanki 2. Jigar Rathod 3. Vaibhav Patel	IJNRD	April 2017	Improvement on existing indigenous models for the benefit of the user in terms of convenience, physical comfort, and affordability
5	"Electric Auto Rickshaw for a Sustainable Transport System"	1. K. S. Reddy 2. S.Aravind-han 3. Tapas K. Mallick	MDPI	2017	Internal transportation of patients in hospitals and disabled passengers in public places like aerodromes, railway stations, and pilgrim sites.
6	"Design of Solar Tricycle For Handicapped People, International Research Journal of Engineering and Technology"	1. Dhanashri Sonar 2. Shantanu Sonar 3. Rohan Katariya	IRJET	2017	Efficiently designed and proved to be a better replacement for indigenous models used by the handicapped

7	"Solar Battery Charging Station and Torque Sensor Based Electrically Assisted vehicle"	1. T. Faraz 2. A. Azad	IEEE	2012	Provision of a reliable and sustainable transport solution with reduced dependency on conventional fuel sources.
8	"Design, Construction and Performance study of a solar Assisted Tri-cycle"	1. Mahadi Hasan Masud 2. Md. Shamim Akhter 3. Sadequl Islam	Periodica Polytechnica Mechanical Engineering	March 2017	Utilizes renewable energy to operate an electrical tricycle, addressing environmental concerns related to fuel-based vehicles.
9	"Design and Fabrication of Magnetic Tricycle for Disabled People"	1. Sachin.s.raj 2. Prabhu P, Parthipan M 3. Rakesh varma S	IER-IREST' 17	2017	Improvement on existing indigenous models for the benefit of the user in terms of convenience, physical comfort, and affordability
10	"Solar Powered Electric Tricycle for Physically Challenged Person"	1. Devaneyan S 2. Kirubakaran V	International Journal of Science, Engineering and Technology Research	December 2016	The integration of renewable energy in the form of solar power enhances the tricycle's appeal as an environmentally conscious and economically viable solution for personal transportation needs.

V. CONCLUSION:

In closing, the multi-purpose three-wheeler electric vehicle (EV) project marks a significant stride in transforming local transportation and tackling the challenges faced by local vendors and individuals with disabilities. By incorporating a range of groundbreaking features, such as a sophisticated rotating seat mechanism, a robust trolley system, and cutting-edge technology, this project paves the way for inclusive, sustainable, and transformative transportation solutions.

The innovative rotating seat, designed with human body measurements in mind and controlled by user-friendly buttons, highlights the project's dedication to improving accessibility and comfort for individuals with disabilities. Meanwhile, the trolley system, featuring a lifting mechanism powered by a high-capacity linear actuator, not only optimizes storage but also caters specifically to the needs of physically challenged and elderly users, emphasizing practicality and inclusivity.

Furthermore, the integration of advanced autonomous driving capabilities, diverse energy sources, and infrastructure development demonstrates the project's commitment to continuous innovation. Looking ahead, the project's potential for growth and development is vast and promising. The strategic incorporation of hybrid and fuel cell technologies, along with adaptive autonomous capabilities, will further enhance the EV's range, efficiency, and versatility, making it suitable for various applications and environments.

Moreover, user-centric design innovations, expanded accessibility features, and strategic global partnerships

will solidify the project's position as a leader in providing inclusive and sustainable transportation solutions.

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