Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 5, May 2024

Multi-Purpose Electric Vehicle for Physically Challenged People

Sanyam Surana
Dept. Computer Engineering
JSPM's JSCOE Pune, India

Ankit Sahal
Dept. Computer Engineering
JSPM's JSCOE Pune, India

Siddhesh Wankhede
Dept. Computer Engineering
JSPM's JSCOE Pune, India

Aditya Malapure
Dept. Computer Engineering
JSPM's JSCOE Pune, India

Dr. D.S. Waghole
Dept. Computer Engineering
JSPM's JSCOE Pune, India

Abstract **- This research paper presents an innovative solution to address the mobility challenges faced by local vendors and physically challenged individuals through the evolution of a multi-purpose electric vehicle (EV). The EV integrates advanced features such as dual batteries with solar charging capability, anti-theft security, and a compact expandable trolley. Key innovations include a rotating seat mechanism based on anthropometry, battery health monitoring, and AR based maintenance applications. Technical specifications encompass battery and solar specifications, highlighting the vehicle's efficiency and range. The paper also outlines the market potential, targeting over 70 million disabled individuals and offering various products and services including app subscriptions and rental facilities. Future plans involve the integration of electric, solar, and hydrogen cell engines, along with fully automated vehicle systems. This research underscores the significance of technological advancements in enhancing accessibility and mobility for diverse user groups, paving the way for inclusive transportation solutions.**

Keywords **- Electric vehicle, multi-purpose, three-wheeler, mobility, innovation, solar charging, anti-theft, rotating seat, battery health monitoring, AR based maintenance, market potential, accessibility, inclusivity.**

I.INTRODUCTION

In the realm of transportation, the advent of electric vehicles represents a significant paradigm shift towards sustainable mobility solutions. Among the diverse array of EVs, multi-purpose three-wheeler electric vehicles emerge as innovative and versatile options, catering to the varied mobility needs of local vendors and individuals with physical disabilities. This research paper begins a thorough investigation of an innovative project aimed at designing and implementing a multi-purpose three-wheeler EV, integrating state-of-the-art technologies and novel design features to enhance usability, efficiency, and accessibility.

At the heart of this project lies a meticulous consideration of motor specifications, where the selection of an optimal motor configuration ensures optimal performance and reliability. The chosen motor, operating on a brushless DC (BLDC) configuration with a power output of 1.2 kW, embodies efficiency, precision, and durability, serving as the powerhouse driving the vehicle forward.

Furthermore, the battery system constitutes an essential element of the EV's architecture, dictating its range, endurance, and overall performance. By employing a dual-battery setup comprising high-capacity prismatic cell lithium-ion batteries, the EV achieves a delicate balance between power output and energy efficiency. This dual-battery configuration not only extends the vehicle's range but also enables seamless swapping, ensuring uninterrupted usage without prolonged downtime for recharging.

Innovatively, the incorporation of solar charging capability enhances the EV's sustainability and reduces its reliance on external power sources. Solar panels, strategically integrated into the vehicle's design, harness renewable solar energy to supplement battery charging, offering a compelling solution for eco-conscious consumers and environmentally sensitive regions.

Moreover, the project incorporates advanced technological features such as an anti-theft system, smart trolley mechanism, and specially designed app for user assistance, elevating the EV's functionality, safety, and user experience.

Through a holistic approach to innovation and sustainability, this research paper endeavors to shed light on the transformative potential of multi-purpose three- wheeler electric vehicles, paving the way for a cleaner, more accessible future of mobility.

II. COMPONENTS DESCRIPTION

Motor Controller:

The motor controller serves as the brain of the electric vehicle (EV), regulating the power delivery from the battery to the motor. In this project, a sophisticated motor controller is employed to ensure precise control, efficient energy conversion, and optimal performance. The controller is equipped with advanced features such as regenerative braking, overcurrent protection, and fault detection mechanisms.

Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 5, May 2024

Specifications:

1. Voltage: 48V
2. Maximum Current: 120A
3. Control Method: Field-Oriented Control (FOC)
4. Communication Protocol: CAN bus
5. Efficiency: > 95%
6. Dimensions: 150mm x 100mm x 50mm
7. Weight: 500g

Motor:

The motor is the heart of the EV, responsible for converting electrical energy into motion. A high-performance brushless DC (BLDC) motor is selected for its efficiency, reliability, and compact form factor. With a power output of 1.2 kW and a maximum speed of 45 km/h, this motor delivers smooth acceleration and precise control, making it ideal for urban commuting and cargo transport applications.

Specifications:

1. Type: Brushless DC (BLDC)
2. Power Output: 1.2 kW
3. Voltage: 48V
4. Maximum Speed: 45 km/h
5. Efficiency: > 90%
6. Cooling: Air-cooled
7. Weight: 8 kg

Solar Panels:

Solar panels are integrated into the EV's design to harness renewable solar energy and supplement battery charging. High-efficiency monocrystalline solar panels with a maximum power output of 100W are utilized to capture sunlight and convert it into electricity. These panels are lightweight, durable, and weather-resistant, making them appropriate for outdoor use.

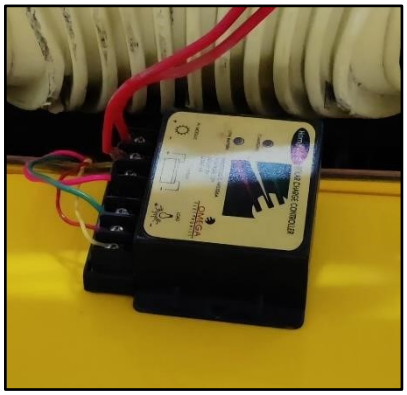
Specifications:

1. Maximum Power: 100W
2. Operating Voltage: 18V
3. Operating Current: 5.5A
4. Dimensions: 1200mm x 505mm x 25mm
5. Weight: 2.0 kg
6. Efficiency: > 20%

Solar Controller:

The solar controller regulates the charging of the batteries from the solar panels, ensuring optimal charging efficiency and preventing overcharging or undercharging. A 48V solar charge controller with a maximum output of 1440W and a maximum charge/discharge current of 30A is employed. This controller features MPPT (Maximum Power Point Tracking) technology to maximize solar energy harvesting and improve overall system efficiency.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 5, May 2024

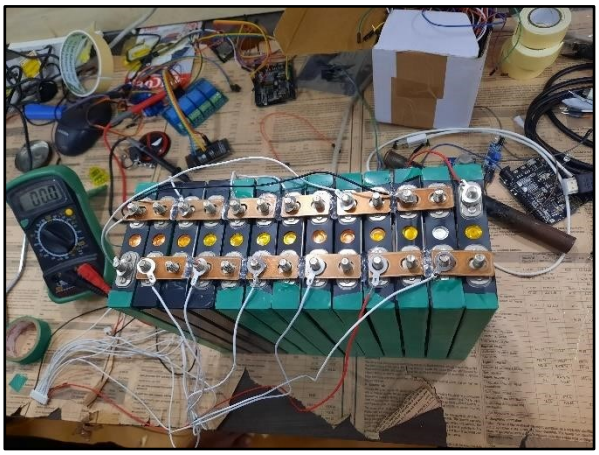


Specifications:

1. Maximum Output Power: 1440W
2. Maximum Charge/Discharge Current: 30A
3. Operating Voltage: 48V
4. Charge Controller Type: Maximum Power Point Tracking (MPPT)
5. Efficiency: > 98%

Battery:

The battery system is an essential component of the EV, providing the energy storage necessary for propulsion and auxiliary systems. Dual prismatic cell lithium-ion batteries with a voltage rating of 48V and a current capacity of 60Ah are employed. These batteries offer ample power and endurance, enabling the EV to achieve a range of 100-110 km on a single charge.



Specifications:

1. Voltage: 48V
2. Current Capacity: 60Ah
3. Composition: Prismatic Cell Lithium-ion
4. Energy Density: > 160 Wh/kg
5. Maximum Discharge Current: 120A
6. Cycle Life: > 1000 cycles

Throttle:

The throttle acts as a conduit between the driver and the motor controller, allowing the driver to regulate the speed and acceleration of the EV. A digital throttle with proportional control is utilized for precise and responsive throttle input. This throttle features adjustable sensitivity settings and ergonomic design for comfortable operation.

Specifications:

1. Type: Digital Throttle
2. Control Method: Proportional
3. Voltage: 0-5V
4. Operating Temperature: -20°C to 70°C
5. Sensitivity Adjustment: Yes
6. Interface: CAN bus

III. PROBLEM FACED BY THE DISABLED PEOPLE

i. Social isolation: Disabled individuals often face social exclusion and isolation due to inaccessible transportation options.

ii. Limited job opportunities: Inaccessible modes of transportation hinders employment opportunities for disabled individuals, leading to financial dependence.

iii. High transportation costs: Commercial transportation services tailored for disabled individuals are often expensive, further limiting their mobility.

iv. Physical discomfort: Conventional transportation modes may not accommodate the specific needs of disabled individuals, leading to discomfort and inconvenience during travel.

v. Lack of independence: Dependence on others for transportation restricts the independence and autonomy of disabled individuals.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 5, May 2024

vi. Inadequate accessibility: Public transportation systems often lack proper accessibility features, making it challenging for disabled individuals to navigate.
vii. Commercial limitations: Local vendors with disabilities face limitations in transporting goods to and from their businesses, affecting their ability to sustain and grow their enterprises.
viii. Safety concerns: Conventional vehicles may not provide adequate safety measures for disabled passengers, increasing the risk of accidents and injuries.
ix. Limited recreational opportunities: Inaccessible transportation options limit the ability of disabled individuals to participate in recreational activities and social events.
x. Physical strain: Physically impaired individuals may experience discomfort and strain while using conventional transportation modes, exacerbating their existing health issues.

IV. OBJECTIVE

The primary objective of this paper and project is to address the pressing mobility challenges faced by local vendors and individuals with physical disabilities through the development and implementation of a multi-purpose three-wheeler electric vehicle (EV). This project aims to leverage innovative technologies and design solutions to create a sustainable, accessible, and user-friendly transportation option that attends to the specific needs of diverse user groups.

The key objectives of the project include:

i. Enhancing Mobility: By providing a reliable and accessible mode of transportation, the project seeks to enhance mobility and independence for individuals with physical disabilities, empowering them to navigate their daily lives with greater ease and confidence.

ii. Improving Accessibility: Through the integration of advanced accessibility features and ergonomic design elements, the project intends to increase the level of accessibility of transportation options for disabled individuals, ensuring equal opportunities for participation in social, economic, and recreational activities.

iii. Promoting Sustainability: By incorporating renewable energy sources and adopting energy-efficient technologies, the project aims to promote sustainability and reduces environmental impact of transportation systems, contributing to a cleaner and greener future.

iv. Fostering Economic Opportunities: The project endeavors to create economic opportunities for local vendors with disabilities by enabling them to transport goods more efficiently and cost-effectively, thereby supporting their livelihoods and economic independence.

v. Driving Innovation: Through the integration of cutting-edge technologies such as battery management systems, anti-theft mechanisms, and smart trolley systems, the project aims to drive innovation in the field of mobility, setting a precedent for future advancements and solutions in the mobility sector.

V. FUTURE SCOPE

The multi-purpose three-wheeler electric vehicle (EV) project has laid a strong foundation for future advancements and innovations aimed at further enhancing mobility, accessibility, and sustainability for people with disabilities and local vendors. Building upon the success of the current project, several avenues for future development and expansion emerge, promising to shape the future of inclusive transportation solutions.

i. Integration of Hybrid and Fuel Cell Technologies: While the current project focuses on electric and solar energy sources, the future scope includes the integration of hybrid and fuel cell technologies. By combining multiple energy resources, such as electric, solar, and hydrogen fuel cells, the EV can achieve greater range, efficiency, and versatility, making it suitable for a wider range of applications and environments.
ii. Enhanced Autonomous Features: Future iterations of the EV may incorporate advanced autonomous driving capabilities, such as lane-keeping assistance, adaptive cruise control, and self-parking functionality. These features will not only improve safety and convenience for users but also enable greater accessibility for individuals with disabilities who may require assistance with driving.
iii. Expansion of Accessibility Features: To further enhance accessibility, future developments may focus on integrating additional features such as voice command controls, gesture recognition, and customizable seating arrangements. These enhancements will cater to the diverse needs of users with different types of disabilities and ensure a more inclusive transportation experience.
iv. Infrastructure Development: The future scope of the project also includes collaboration with government agencies and urban planners to develop accessible infrastructure, including designated EV charging stations, wheelchair ramps, and tactile guidance systems. By improving infrastructure, the project aims to create a more supportive environment for EV adoption and usage.
v. Global Expansion and Collaboration: As the project gains traction and recognition, there is an opportunity for global expansion and collaboration with international partners and organizations. By sharing best practices, exchanging knowledge, and leveraging resources, the project can amplify its impact and reach new markets, thereby benefiting a larger segment of the population.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 5, May 2024

In essence, the future scope of the multi-purpose three-wheeler electric vehicle project is vast and promising, with opportunities for continued innovation, collaboration, and impact. By embracing emerging technologies, enhancing accessibility features, and fostering partnerships, the project is poised to lead the way towards a more inclusive and sustainable future of transportation for all.

VI. CONCLUSION

In conclusion, the development and implementation of a multi-purpose three-wheeler electric vehicle (EV) represent a significant step towards addressing mobility challenges faced by individuals with disabilities and local vendors. Through innovative design solutions, advanced technologies, and a commitment to accessibility, sustainability, and inclusivity, this project has the capacity to make a transformative impact on the lives of diverse user groups.

The project's objectives, including enhancing mobility, improving accessibility, promoting sustainability, fostering economic opportunities, and driving innovation, have been successfully addressed through the integration of components and features. From the high-performance motor and battery system to the innovative trolley mechanism and solar charging capability, each aspect of the EV has been meticulously created to fulfil the specific needs of users and overcome existing barriers in transportation systems.

Moreover, the project's socio-economic implications are significant, offering employment opportunities, reducing transportation costs, and promoting economic empowerment for marginalized communities. By providing a reliable, affordable, and accessible mode of transportation, the multi-purpose three-wheeler EV empowers people with disabilities to lead independent and fulfilling lives while enabling local vendors to expand their businesses and reach new markets.

Looking ahead, the project holds promise for further innovation and development, with future plans including the integration of additional energy sources, advanced safety features, and autonomous driving capabilities. Through ongoing research, collaboration, and community engagement, the project aims to continue making strides towards a more inclusive, sustainable, and equitable transportation ecosystem.

In essence, the multi-purpose three-wheeler electric vehicle project represents not only a technological achievement but also a testament to the ability of innovation and collaboration in addressing societal challenges and improving the quality of life for all. As we move forward, let us remain committed to building a future where mobility is accessible to everyone, regardless of ability or circumstance.

VII. REFERENCES

[1] Algarni S, Mellouli S and Abhilash, “Performance Analysis of a Solar Powered Wheel chair”, Journal of Engineering Technology, Volume 6, Special Issue on Technology Innovation and Applications, October 2017, pp.212-216.

[2] Madhusudhan T, Madhav P, Pranav S Meghlal and Rahul Ashok, “Design and Development of Wheelchair Accessible Ramp for Scooters”, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Volume 6, Issue 6, ISSN (online): 2319-8753, ISSN (print): 2347-6710, June 2017, pp.11534-11540.

[3] Jawale P R, Gabhane A R, Baje K G and Patil D N, “A Review on Modern Hybrid Tricycle for Handicapped Person”, International Journal of Research in Advent Technology, Special Issue Nation Conference “CONVERGENCE 2017”,(E-ISSN: 2321- 9637), April 2017,pp.113-118.

[4] Ravi Solanki, Jigar Rathod and Vaibhav Patel, “Modification of Delta Tricycle”, International Journal of Novel Research and Developement (IJNRD), Volume 2, Issue 4, ISSN:2456-4184, www.ijnrd.org, April 2017, pp.35-38.

[5] International Energy Outlook 2016-Transporation Sector Energy Consuption-Energy Infromation Administation. Available online: https://www.eia.gov/outlooks/ieo/transportation.cfm (accessed on 15 April 2017).

[6] K. S. Reddy, S.Aravind-han and Tapas K. Mallick: Electric AutoRickshaw for a Sustainable Transport System, MDPI, Energies, 2017, 10, 754; doi:10.3390/en10060754.

[7] Dhanashri Sonar, Shantanu Sonar, Rohan Katariya: Design of Solar Tricycle For Handicapped People, International Research Journal of Engineering and Technology (IRJET), 2017, Vol. 4, No.8, pp.1115- 1129.

[8] T. Faraz and A. Azad: Solar Battery Charging Station and Torque Sensor Based Electrically Assisted vehicle, IEEE conference Global Humanitarian Technology Conference, 2012. DOI: 10.1109/GHTC.2012.62.

[9] Mahadi Hasan Masud, Md. Shamim Akhter and Sadequl Islam, “ Design, Construction and Performance study of a solar Assisted Tri-cycle”, Periodica Polytechnica Mechanical Engineering, Volume 61(3), revision 06, March 2017, https://doi.org/10.3311/PPme.10240, pp.234-241.

[10] Sachin.s.raj, Prabhu P, Parthipan M and Rakesh varma S, “Design and Fabrication of Magnetic Tricycle for Disabled People”, International Conference on Innovative Researches in Engineering in Engineering, Science & Technology (IER-IREST’ 17), (2017), pp.9-12.

[11] Devaneyan S and Kirubakaran V “Solar Powered Electric Tricycle for Physically Challenged Person”, International Journal of Science, Engineering and Technology Research, Volume 5, Issue 12, ISSN: 2278-7798, December 2016, pp.3475-3478.

[12] Jayaprabakar J, Saikiran K, Paranthaman P, Nirmal Raj R and Arunkumar T, “Design of Affordable Electric Vehicle for Handicapped”, International Journal on Design & Manufacturing Technology, Volume 10 No.2, July 2016, pp.4-6.

[13] Venkatesh N, Rajesh S, Srisankar G and Dhanapal M, “Reverse Gear Mechanism in Two Wheeler for Physically Challenged People”, International Journal of Scientific & Engineering Research (IJSER), Volume 7, Issue 5, ISSN: 2229-5518, May 2016, pp.121-127.

[14] Samip Mahta, Deven Godhani, Nauman Vadnagarwala and Chirag Shivdas, “Foot Steered Tricycle”, International Journal of Design and Manufacturing Technology, Volume 8, Issue 1, ISSN (Print): 0976-6995, ISSN (online):0976-7002, JanApr 2016, © IAEME Publication, pp.13-29.

[15] Latikesh Khedkar, Ketan warjrkar, Krishna Yadav and Ashwin Gajbhiye, “Design & Fabrication of Reverse Gear Mechanism for Handicapped Person Vehicle”, International Journal of Scientific Development and Research, Volume 1, Issue 3, ISSN: 2455-2631, March 2016, pp.113-115.

[16] Weijun TAO*, Yongxiang JIA* and Tao LIU**, “A Novel Wheel-track Hybrid Electric Powered Wheelchair for stair Climbing”, Journal of Advanced Mechanical Design System and Manufacturing (JSME), Volume 10, No.4, Paper No. 16-00053, DOI: 10.1299/jamdsm.2016jamdsm0060, January 2016, Copyright © 2016 The Japan Society of Mechanical Engineers.

[17] Ajit A. Mohekar, Savita V. Kendre and Tanmay N. Shah, “Design of an Innovative Retrofitted Tricycle For a Disabled Person”, International Journal of Advanced Research in Science and Engineering, Volume 4, Issue 07, ISSN: 2319-8354, July 2015, pp.275-288.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 5, May 2024

[18] Snehal G. Bali, Amit Kushwaha, Pratik Dhote and Chetan Nadanwar, "Fabrication of Solar Powered Tricycle for Handicapped Person", International Journal for Innovative Research in Science & Technology (IJIRST), Volume 1, Issue 10, ISSN(online): 2349-6010, March 2015, pp.169-173.

[19] Abhishek K. Saw, Pratik Dhote, Mrunal Gaidhani and Pratik Pande, "Literature Review on Solar Powered Tricycle for Handicapped Person", International Journal for Innovative Research in Science & Technology, Volume 1, Issue 10, ISSN(online): 2349-6010, March 2015, pp.174-179.

[20] Vishnuprakash P, Rajesh R, "Design and Concept Evaluation of Tricycle for Aged and Orthopaedic Differentially Abed Person", International Journal of Computer Applications, Volume 111, Issue 15, ISSN: 0975-8887, Feb.- 2015, pp.18-25.

[21] Subrahmanyam V, Anjani Kumar B and Naresh K "Fabrication Of Tri-Wheeled Electric Vehicle To Aid Disabled", International Journal of Technology Enhancements and Emerging Engineering Research, Volume 3, Issue 04, ISSN: 2347-4289, (2015), pp.23- 26.

[22] Satish Kumar Dwivedi, Deepak Kumar Yadav, Ashutosh Mishra and sujeet Kumar, "Design and Fabrication of a Motorized Tricycle for Physically Challenged Persons", International Journal of Engineering Science Invention, ISSN (Online): 2319- 6734, ISSN (Print): 2319-6726, www.ijesi.org, Volume 3, Issue 4\\ April 2014\\ pp.29-32.

[23] Rakesh P. Shende, Surbhi A. Tode and R.U. Sambhe, "Design and Fabrication of Pneumatic Tricycle", International Journal for Engineering Applications and Technology (IJFEAT), March 2014, ISSN: 2321-8134, http://www.ijfeat.org, pp.202- 209.

[24] Ravikumar Kandasamy, Sachin Raut, Deep Varma and Ganesh There, "Design of Solar Tricycle for Handicapped Person", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 5, Issue 2, e-ISSN: 2278-1684, (Jan.- Fab.2013), pp.11-24.

[25] Sathish Kumar B, Vinod K. Banthia and Alok Kumar Ray, "Design of Three Wheeler Vehicle for Physically Challenged People", SASTECH Journal, Volume 12, Issue 1, April 2013, pp.80-89.