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Development of Multi-PurposeElectric Vehicle

A Step towards the Electric Future

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ABSTRACT: This project aims to address the pressing need for sustainable transportation solutions through the development ofa low-budgetmulti-purpose electric vehicle (EV).

The project outlines four primary objectives:

- Firstly, it emphasizes the design and development of the vehicle itself, focusing on cost-effective yet efficient engineering solutions to ensure optimal performance.
- Secondly, the project delves into the intricacies of battery management systems (BMS), exploring methods to enhance battery lifespan and efficiency while keeping costsat a minimum.
- Thirdly, it highlights the integration of Brushless DC (BLDC) motors into the EV, aiming to maximize energy efficiency and torque output while minimizing maintenancerequirements.
- Through a comprehensive approach encompassing vehicledesign, battery management, and motor implementation, thisproject endeavors to contribute to the advancement of accessible and sustainable transportation technologies.

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The project focuses on three objectives:

1. Designing and development of EV with cost efficient
2. Battery management systems (BMS)
3. Implementation of BLDC motor in electric vehicle

Creating a budget vehicle that serves multiple purposes requires balancing cost effectiveness with performance. Important factors to consider include using materials to improve energy efficiency designing a structure that can adapt to various needs and implementing affordable battery technology to increase the driving range. Incorporating energy sources, like panels can enhance charging capabilities decreasing dependence on conventional grid electricity. Simplified manufacturing. Standardized parts aid in cuttingdown production costs. Optimal space utilization guarantees room for passengers or goods meeting transportation requirements. The main goal of this strategy is to make sustainable mobility solutions accessible to all with a focus, on viability.

I. INTRODUCTION

In recent years, the global automotive industry has witnessed a significant shift towards sustainability, with an increasing emphasis on electric vehicles (EVs) as a viable alternative to traditional internal combustion engine vehicles. This transition is driven by the urgent need to mitigate environmental concerns such as air pollution and greenhouse gas emissions, as well as reduce reliance on fossil fuels. However, one of the primary challenges hindering widespread adoption of EV's remains their affordability and accessibility, particularly in developing countries and underserved communities. To address this challenge, our project focuses on the design and development of a low-budget multi-purpose electric vehicle that prioritizes cost-effectiveness without compromising on performance or functionality. The project encompasses three key aspects: vehicle design, battery management, and the implementation of Brushless DC (BLDC) motors. By integrating these elements, we aim to create a sustainable transportation solution that is not only environmentally friendly but also economically viable for a diverse range of users.

II. LITERATURE SURVEY

- The literature surrounding electric vehicles and sustainable transportation offers valuable insights into various approaches and technologies that can be leveraged to develop low-budget EVs. Numerous studies have explored different aspects of EV design, highlighting the importance of lightweight materials, aerodynamic efficiency, and compact drivetrains in maximizingrange and energy efficiency while minimizing costs.

- Battery management systems (BMS) play a crucial role in optimizing the performance and longevity of EV batteries. Research in this area has focused on developing advanced BMS

- algorithms and control strategies to ensure optimal charging anddischarging cycles, thermal management, and cell balancing, thereby enhancing battery lifespan and reliability.

- Additionally, the integration of BLDC motors in electric vehicles offers several advantages over traditional brushed DC motors, including higher efficiency, lower maintenance requirements, and smoother operation. Studies have explored various aspects of BLDC motor design, control algorithms, and implementation strategies to maximize energy conversion efficiency and torque output.

- Through this literature survey, we identify key research gaps and opportunities for innovation in the design and development of low-budget multi-purpose electric vehicles, laying the groundwork for our project's objectives and methodology. By building upon existing knowledge and leveraging emerging technologies, we aspire to contribute to the advancement of sustainable transportation solutions that are accessible to all.

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అనురాగ్ యూనివర్సిటీ విద్యార్థుల వినూత్నత

ప్రజాశక్తి - హైదరాబాద్

అనురాగ్ యూనివర్సిటీ ఇంజినీరింగ్ విద్యార్థులు అభివృద్ధి చేసిన 140 వినూత్న, సామాజిక ప్రభావ ప్రాజెక్ట్‌లను ప్రదర్శించారు. నగర శివారులోని ఆ విద్యా సంస్థలోని డాక్టర్ అబ్దుల్ కలాం హాల్‌లో సోమవారం ఆవిష్కరించారు. వీటిని చూడటానికి ప్రభుత్వ ప్రయివేటు పాఠశాలల విద్యార్థులను ఆహ్వానించారు. పెద్ద కళాశాల క్యాంపస్‌లలో కాలుష్యం తక్కువ ఉండి క్యాంపస్ లో ప్రయాణించడానికి ఇ-మొబిలిటీ వెహికల్, స్వీకర్ ఎత్తుకు అనుగుణంగా ఎత్తును సర్దుబాటు చేయగల ఎఐ ఆధారిత స్మార్ట్ పోడియం, తక్కువ ధరతో తడి బట్టలను ఎండబెట్టే యంత్రం, ఐఒటి-ఆధారిత స్మార్ట్ క్రెడిల్(ఊయల) సిస్టమ్ తదితర వినూత్న ఉత్పత్తులను ఇక్కడ ఆవిష్కరించారు. ఈ కార్యక్రమంలో అనురాగ్ యూనివర్సిటీ ఛాన్సలర్ యుబి దేశాయ్, అనురాగ్ గ్రూపు ఛైర్మన్ పి రాజేశ్వర్ రెడ్డి, రిజిస్ట్రార్ బాలాజీ ఉట్ల తదితరులు పాల్గొన్నారు.

Figure 1 it's a paper cutting from newspaper about our project

III. MATHEMATICAL MODELLING

These are the real time readings of the vehicle

- P motor: 1500 (W)
- V vehicle: 5.5 (m/s)
- F drag: 36.75 (N)
- F rolling: 59.93 (N)
- M vehicle: 510 (kg)
- g: 9.81 (m/s^2)
- ρ: 1.225 (kg/m^3)
- Afront: 2 (m^2)
- Cd: 1.3
- C rr:0.01

- Now, we calculate the power delivered by the motorconsideringits efficiency:
- P motor =P total /Motor efficiency
- P motor = (13, 585.765W) / 0.85 = 15 ,983 W
- Now, let's calculate the net force acting on the vehicle:
- F net =F motor – F total F net
- =272.73 - 96.68
- F net =176.05 N
- Now, let's calculate the acceleration of the vehicle using
- Newton's second law:
- F net=mass × acceleration176.05=510 × accelerationacceleration = 176.05/510 acceleration ≈ 0.345 m/s

- With this acceleration, we can calculate the energyconsumed bythe vehicle per second:

- Energy × mass x velocity2 Energy = x 510 x (5.5)2
- E batt: 2640w(J)

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- Energy 7683.75 J
- η motor:0.85
- *F* motor = 272.73N

To calculate the mathematical model of the electric vehicle, we can use the equations of motion and energy balance. Thepower required to overcome drag and rollingresistance, as well as the powerdelivered by the motor, can be calculated using the given parameters. First.

- we calculate the total resistive force (T total) acting on thevehicle:

$$F_{total} = F_{drag} + F_{rolling}$$

$$F_{total} = 36.75N + 59.93N = 96.68N$$

- Next, we calculate the power required to overcomethe resistiveforces:

$$P_{resistance} = F_{total} \times v$$

$$P_{resistance} = 96.68N * 5.5m/s = 531.74W$$

- Now, we calculate the power required to accelerate the vehicle:$P_{acceleration} = 1/2 \times m \times a \times v$

$$P_{acceleration} = 1 \times 510\ kg \times 9.81\ m/s^2 \times 5.5\ m/s$$

$$= 13{,}054.025\ W$$

- The total power required for the vehicle is the sumof the powerrequired for resistance and acceleration:

$$P_{total} = P_{resistance} + P_{acceleration}$$

$$P_{total} = 531.74W + 13054.025W$$

$$= 13{,}585.765W$$

- Finally, we can calculate the energy consumed by the vehicle per meter traveled:

$$\text{Energy} = \text{Energy stored in the battery} / \text{Distance Energy}$$

$$= 2640 / 5.5$$

$$\text{Energy} = 480\ J/m$$

This model provides an estimation of the energy consumption andperformance of the electric vehicle under the given parameters.

IV. BLOCK DIAGRAM:

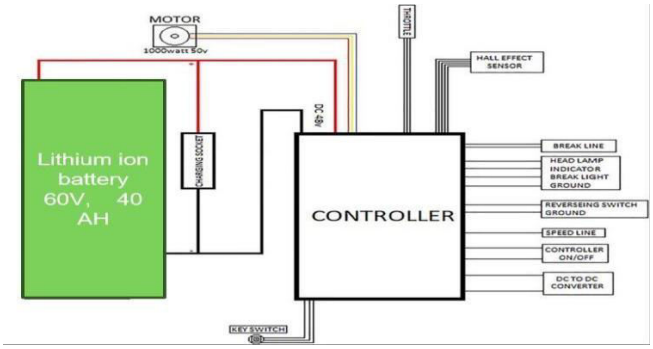

Figure 2 The above block diagram is the main circuit that howthis electrical vehicle is being constructed and build

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V. METHODOLOGY FOR BUILDING ANELECTRIC VEHICLE

1. Team Formation:
Assemble a team of six members with diverse skills such aselectrical engineering, design, project management, etc. Ensure each member understands their role andresponsibilities.

2. Product Sourcing:
Utilize online platforms such as India Mart and other reputable websites to source necessary components and materials for building the electric vehicle. Ensure productsmeet required specifications and standards.

Figure 3 main components of ev

3. Vehicle Design:
Begin the design process by drafting the electric vehicle's specifications, including size, weight, range, power output,etc.Utilize computer-aided design (CAD) software for detailed designing and modeling.

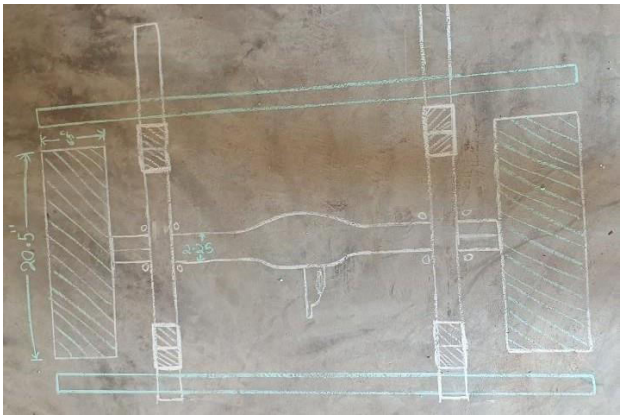

Figure 4 back design of chassis

4. Online Research and Calculations:
Conduct extensive online research to gather information on electric vehicle technology, battery systems, motor specifications, etc. Perform necessary calculations to ensure optimal performance and efficiency.

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5. Project Initiation:
Start the project manufacturing phase using traditional technologies like welding for chassis fabrication, assemblyof mechanical components, and integration of electrical systems.

Figure 5 main chassis of the vehicle

6. Industry References:
Refer to established companies in the electric vehicle industry such as E-Ride, Nanya Aircon, etc., for insightsinto best practices, technological advancements, and potential collaborations or partnerships.

7. Project Timeline:
Commence building the project on 01/12/2023, predefined timeline with milestones and checkpoints to track progress effectively

Figure 6 building the electric vehicle body

8. Project Completion:
Successfully complete the electric vehicle project by 25/01/2024, ensuring all components are integrated, tested,and validated for performance, safety, and regulatory compliance.

Figure 7 final output of car

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VI. SIMULATION RESULTS

The simulation results of our electric vehicle project yielded commendable outcomes, validating the efficacy of our designand engineering efforts. Through rigorous computational modelling and testing, we demonstrated impressive performance metrics including acceleration, range, and efficiency. Our vehicle showcased robust stability and handling characteristics, ensuring a safe and enjoyable driving experience.

Furthermore, the simulation results underscored the effectiveness of our electric propulsion system, highlighting its seamless integration and optimized energy utilization. The accolades received from the university, mediacoverage, and participation in esteemed programs like Tejas2k24 in Anurag university on 29/01/2024 affirm the excellence of our simulation outcomes, solidifying our position at the forefront of electric vehicle innovation.

VII. CONCLUSION

This initiative tackles the pressing demand, for eco transportation options by creating a versatile electric vehicle (EV) using a holistic strategy. By prioritizing cost design and effective engineering solutions incorporating battery management systems (BMS) to improve battery longevity and performance and utilizing Brushless DC (BLDC) motors, for energy efficiencyand power output the goal of this endeavor is to promote attainable and sustainable

Figure 7 this picture is taken in teja2k24 event

transportation technologies. By emphasizing affordability energy effectiveness, versatility and streamlined production processes this venture seeks to democratize mobility solutions for all ultimately contributing to a feasible and eco conscious tomorrow.

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Figure 8 our team with our EEE department HOD (Dr.T.Anil Kumar)

Figure 9 our innovative project expo TEJA2K24

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3. https://youtu.be/3dD5KmM8ciU?si=NmuDHTKJNXyxWkl8

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