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Driving Towards a Greener Future: Innovations in Solar Electric Vehicles

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Abstract - *In display situation, the world is confronting efficiency of fossil powers and climb in their costs due to ever expanding request. From this time forward, it has ended up basic to revolutionize our way of living by starting a green insurgency within the car industry. The greatest concern for the world populace nowadays is to breathe new discuss and in this way combat related wellbeing issues. This paper centers on equipment advancement of Crossover Electric vehicle to address this extreme circumstance and has been coupled with green innovations: sun powered and regenerative braking, which not as it were offer an elective to Inside Combustion driven Vehicles but can to help us take a jump forward in accomplishing economical worldwide advancement by lessening discuss contamination and ever-increasing temperature of the soil. Half breed electric vehicle's setup basically comprises of motor controller ,Lasting magnet synchronous motor (PMSM) motor and battery bank which can be utilized by the commuter to create wanted level of regenerative control utilizing most recent innovation. It is encouraged went with by sun-based module, set up on the beat of the vehicle controlled by a charge controller to charge the battery bank. Being diverse from others our major center will be on the aesthetics of our car where we'll be reviving the brilliant period of 90s when individuals were exceptionally much enthusiastic and connected to their cars.*

***Key Words*: Pmsm Motor, Lithium ion battery, Polycrystylline solar panels, Space frame chassis, Transmission, Aesthetics,etc**

1. INTRODUCTION

The current global warming crisis poses a significant risk to society, largely attributed to the emission of carbon dioxide from vehicle exhaust due to the combustion of fossil fuels, which pollutes the environment. One promising solution to this issue is the use of hybrid vehicles. Typically, hybrid vehicles combine various propulsion systems, including electric, solar, and internal combustion engines. However, our approach differs by integrating solar power and electric propulsion, resulting in what we term a Solar-Powered Vehicle. This vehicle can operate on solar energy, assisted by an electric motor and batteries, thereby producing zero emissions in real-life applications. Additionally, our vehicle's sleek design aims to enhance the passengers' experience. Currently, hybrid electric vehicles are emerging in the market, but they still require periodic charging, which can increase electricity costs and reliance on electrical sources. Our hybrid solar vehicle addresses these challenges while supporting a greener environment.

2. PROBLEM DEFINITION

In the contemporary era, the global community is grappling with the dual challenges of reducing carbon emissions and ensuring sustainable mobility. One of the pressing problems we face is the pervasive use of fossil fuel-powered vehicles for example internal combustion engine (ICE) vehicles, these vehicles burn fossil fuels, releasing a variety of harmful pollutants into the atmosphere, including carbon monoxide, nitrogen oxides, particulate matter, and carbon dioxide. Our project seeks to develop a Solar-Powered Electric Vehicle (SEV) as a potential solution to this problem. By harnessing the power of sunlight, this technology offers a pathway to a greener and more sustainable future of transportation, aligning with the global goals of reducing carbon footprint and dependence on finite energy sources." This problem definition outlines the current environmental and sustainability challenges related to transportation and introduces the solar-powered electric vehicle as a solution to these issues. It sets the stage for the project's goals and objectives.

3. MATERIAL MIX: CRAFTING VEHICLE COMPONENTS

The material we used for our chassis is mild steel. There are several reasons why mild steel a popular choice for car chassis.

A. Cost-effective:
Mild steel is one of the foremost affordable types of steel. This is often a major thought for car manufacturers who deliver vehicles at a competitive cost.

B. Formability:
Mild steel is relatively simple to twist and shape. This makes it well-suited for the complex bends and angles that are often required in car chassis design.

C. Weldability:
Mild steel can be effectively welded together to make a solid and secure chassis. This can be imperative for ensuring the integrity of the car's structure.

D. Strength:
Whereas not the strongest steel, mild steel still offers great pliable quality, meaning it can withstand a critical sum of drive some time recently breaking. This is often critical for occupant security within the occasion of a collision.

E. Ductility:
Mild steel is ductile, meaning it can deform underweight without cracking. This allows the chassis to retain a few of the affect vitality in a crash, making a difference to ensure the inhabitants.

F. Recyclable:
Like most steel, mild steel is 100 percent recyclable. This is an important environmental benefit, as it reduces the need to mine new resources.

4. MOTOR MOTIVE: THE MOTOR BEHIND THE CHOICE

A Permanent Magnet Synchronous Motor (PMSM) is an electric motor that employs lasting magnets to form a attractive field inside the rotor. It works on the guideline of synchronicity, where the stator's attractive field pivots at the same speed as the rotor, coming about in effective and exact motor control. PMSM motors are known for their tall proficiency, great torque control, and calm operation. They utilize in different applications, counting electric vehicles, mechanical apparatus, mechanical autonomy, and renewable vitality frameworks, due to their energy efficient and dependable execution.

5. MOTOR MECHANISM: POWERING THE DRIVE

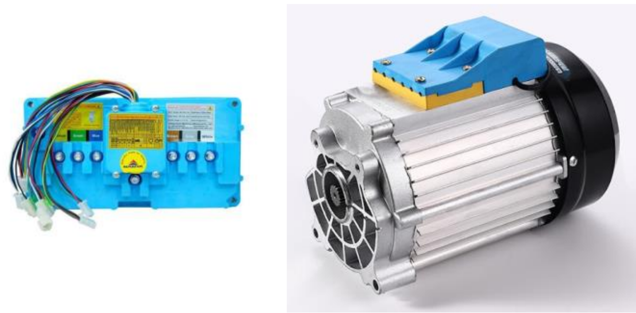

Fig -1: PMSM Motor of 60v/3kw

The motor we used is PMSM (Permanent magnet synchronous motor). There are a few points of interest that make Permanent Magnet Synchronous Motors (PMSM) a compelling choice for electric vehicles (EVs)

A. High Efficiency:
PMSMs boast superior effectiveness compared to induction motors, commonly used in older EVs. This interprets to a longer driving extend on a single charge, as less energy is wasted as heat.

B. High Power Density
PMSMs can pack a lot of power into a compact design. This is crucial for EVs where space is frequently constrained, and lighter weight translates to a superior extend.

C. *High Torque Density:*
Compared to power density, PMSMs convey high torque for their size. This interprets to strong acceleration and great hill-climbing capacity for the EV.

D. Smooth and Calm Operation:
Due to their design, PMSMs produce negligible torque ripples, resulting in smoother and calmer operation compared to induction motors. This enhances traveler comfort within the EV.

E. Good Controllability:
The permanent magnets and inherent design of PMSMs allow for precise control over motor speed and torque, leading to better overall performance and effectiveness of the electric drivetrain.

F. *Wide Speed Range:*
PMSMs can successfully work over a wide run of speeds, which is well-suited for the varying driving conditions EVs encounter.

6. POWER SOURCE INTRODUCTION

A prismatic cell battery may be a sort of a battery in which the cells are stacked in columns. This sort of battery is frequently utilized in cars. It is one sort among numerous within the field of electrochemical cells. These batteries store vitality by changing over chemical potential into electrical current. Prismatic cells are more often than not rectangular, and they have more noteworthy control thickness than round and hollow cells. They moreover offer way better cold-weather execution, tall vitality thickness, and unwavering quality and are less inclined to harm from vibration, making them a prevalent choice for applications where space productivity and execution are significant.

7. BATTERY MOTIVE: RATIONALISING THE POWER SOURCE

Fig -2: Lithium-ion battery of 60v/70Ah

The battery we used is a Lithium-ion battery. Lithium- ion batteries reign supreme in electric vehicles (EVs) due to several key characteristics that perfectly complement the demands of electric propulsion.

A. High Energy Density:

This refers to the amount of energy a battery can store relative to its weight and size. Lithium-ion batteries boast the highest energy density among practical battery innovations for EVs. This interprets to a longer driving extend on a single charge, a crucial factor for customer adoption of EVs.

B. Long Cycle Life:

Lithium-ion batteries can experience numerous charge and discharge cycles before showing significant degradation in performance. This means a longer lifespan for the battery pack, reducing replacement costs for EV owners.

C. High Power Density:

Along with high energy density, lithium-ion batteries can deliver significant power output in short bursts. This is essential for EVs, as it allows for quick acceleration and strong hill-climbing ability.

D. Lightweight:

Lithium is the lightest element used in batteries, contributing to the overall weight reduction of the EV. Lighter weight interprets to better effectiveness and potentially even longer range.

E. Relatively Fast Charging:

Compared to some other battery innovations, lithium-ion batteries can be recharged at a faster rate, reducing downtime while on the road.

F. *Low Self-Discharge:*

Lithium-ion batteries lose negligible charge when not in use, not at all like older battery technologies that might lose a significant amount of charge over time while parked.

8. PANEL PREFERENCE: HARNESSING SOLAR ENERGY

Polycrystalline sun powered boards are a prevalent innovation within the field of sun powered vitality. These panels are made from numerous silicon parts melded together, recognizing them from monocrystalline panels. Their blue tone and grainy appearance set them apart visually. Whereas somewhat less effective than monocrystalline partners, they offer fetched preferences due to less complex fabricating forms. Polycrystalline boards perform dependably over different conditions, making them appropriate for private, commercial, and utility-scale solar installations. Their affordability and dependable performance make them a well-known choice for those seeking to harness solar control.

9. PANEL MOTIVE: ILLUMINATING THE CHOICE OF SOLAR TECHNOLOGY

Fig -3: Solar Pane of 21Volts/ 12 Amps

The solar panels we have used are flexible polycrystalline solar panels. Flexible polycrystalline solar panels offer some potential advantages for use on EVs. Here's a breakdown:

A. Conformity:

Their flexible nature allows them to be curved and molded to fit non-traditional surfaces on an EV, such as the hood or a curved roof section. This empowers the capture of additional sunlight from areas that rigid panels wouldn't be suitable for.

B. Weight Reduction:

Flexible solar panels are typically lighter than their rigid counterparts due to the thinner profile and different materials used. This could contribute to a slight improvement in overall EV range.

C. Potentially Easier Installation:

The flexibility could simplify installation on some EVs, especially for curved surfaces. They might require less complex mounting frameworks compared to rigid panels.

9. TRANSMISSION TACTICS: DRIVING GEAR CHOICES

Transmission systems, such as belt, shaft, and gear types, along with innovative electronic and magnetic transmission technologies, offer potential solutions for integration into our solar-powered electric vehicle. Each transmission type comes with its own set of advantages and limitations, influencing factors such as efficiency, torque delivery, weight, and complexity.

10. FINISHING TOUCHES: POLISHING VEHICLE PERFECTION

There were various steps involved in finishing process which are mentioned below:

A. Step1:

We performed grinding operation on entire chassis using grinder wheels and sandpapers of different grit 60, 150 and 240.

B. Step2:

We applied polymer resin wherever it was necessary. After applying polymer resin, we grinded the excess resin.

C. Step3:

We applied red oxide on the entire chassis to prevent it from corrosion and to increase its durability.

D. Step4:

We spray painted the entire chassis with silver (36) spray paint color and all other components like differential, lower arm, upper arm etc. with matt black (4) spray paint.

11. AXLE BASED SHAFT TRANSMISSION IN SOLAR ELECTRIC VEHICLE

A. Reason for choosing axle as transmission shaft:

1) ***Simplified Fabrication:*** The circular rod design of both the motor and differential output shafts simplifies fabrication. This compatibility allows for easier integration with the axle shaft, streamlining the manufacturing process.

2) ***Enhanced Compatibility:*** The presence of internal grooving on the motor shaft and the inclusion of CV joints and slip joints on the differential shaft ends ensure compatibility and proper freedom of movement. This facilitates smooth rotational motion and minimizes stress on the drivetrain com- ponents.

3) ***Optimized Efficiency:*** By utilizing these design features, the transmission system achieves optimal efficiency. The seamless integration of components minimizes energy loss and ensures reliable power transfer from the motor to the differential, enhancing overall vehicle performance.

12. FABRICATION CHALLENGES: TACKLING CONSTRUCTION HURDLES

" Specialized Challenges Encountered During the Construction of a Solar- Powered Electric Vehicle "

A. Manufacturing Upper Body:

Constructing the upper body of the vehicle posed significant challenges, primarily due to the utilization of circular rods in the space frame chassis construction. Forming rods at irregular angles, such as 58, 59, and 64 degrees, introduced complexities and increased the risk of dimensional inaccuracies. Welding these bars while ensuring precise alignment in multiple axes simultaneously proved technically challenging, requiring innovative solutions to manage the manufacturing process effectively.

B. Lower Arm Suspension:

The lower arm suspension encountered issues stemming from the weight of the suspension system, leading to deformation. To address this, hammering and welding operations were employed to restore structural integrity and resolve the bending problem.

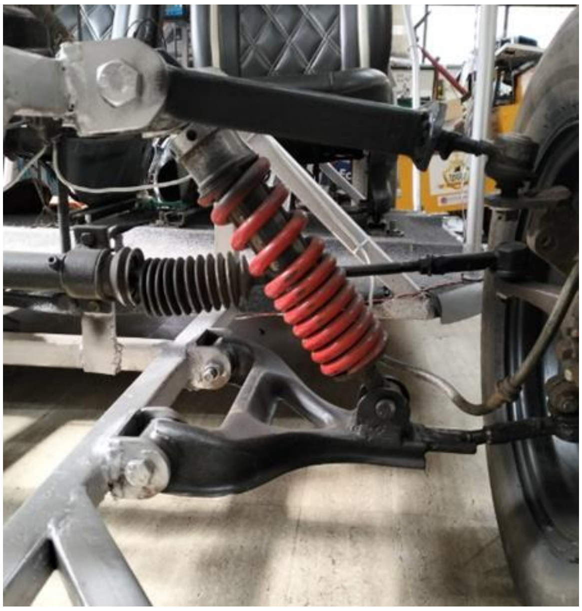

Fig 4: Lower arm

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C. Upper Arm Fabrication:

Fabricating the upper arm proved time-consuming, initially utilizing circular rods. However, after a thorough survey, it was determined that using square bars with appropriate measurements akin to the lower arm proved to be a more suitable approach. This adjustment optimized the structural integrity and functionality of the upper arm component.

Fig -5: Upper arm

D. Steering System Alignment:

Calculating the steering wheel rotation, which was one and three-fourths of a standard rotation, presented challenges resulting in wheel misalignment. Through meticulous calculations, the correct steering wheel rotation ratio was determined, resolving the misalignment issue and ensuring proper wheel alignment.

E. Differential Movement Control:

Managing various forces acting on the differential, including upward, downward, sideways, and rotational forces, required an intricate study. To address this, an additional trailing arm was manufactured and attached to the top of the differential to restrict its rotational movement, enhancing stability and control.

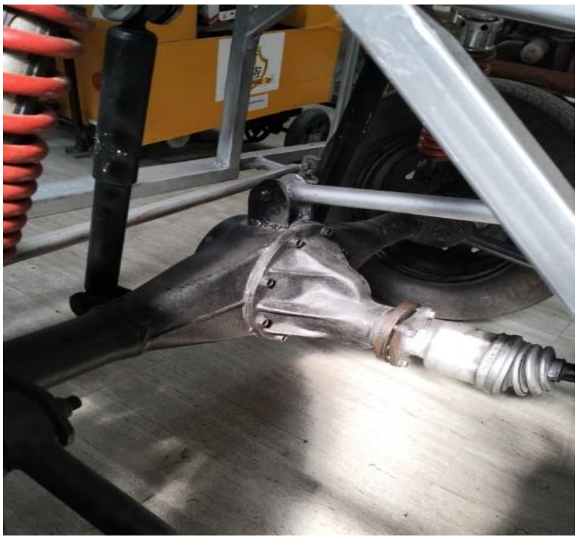

Fig -6: Differential

13. PERFORMANCE PROFILE:

A. Maximum Speed:

The top speed of the electric vehicle can reach to 90 kilometers per hour.

B. Range:

The distance EV can travel on a single charge under full motor load, it can cover 45 kilometers, but under decent motor load conditions, it can exceed 100 kilometers.

C. Efficiency:

The vehicle's ability to maximize energy usage, resulting in extended range performance and reduced environmental impact.

D. Vibration and Noise Assessment

Ensuring passenger comfort and vehicle quality by evaluating levels of vibration and noise during operation.

E. Load Capacity:

Testing the EV's ability to carry heavy loads, with results showing it can handle payloads of up to 800 kilograms, making it suitable for commercial applications like cargo transport or urban delivery services.

F. Hydraulic Disc Brakes:

Implementing a braking system on the front side of the vehicle to enhance safety and control, providing reliable stopping power, and boosting driver confidence.

Fig -7: Actual Model

14. CONCLUSION

Solar-powered electric vehicles represent a promising solution for reducing greenhouse gas emissions and fostering a more sustainable transportation sector. By harnessing solar energy, these vehicles operate with minimal environmental impact, contributing to the fight against climate change while offering lower operational costs due to their ability to charge from sunlight. They align with principles of sustainable transportation by reducing energy consumption and minimizing environmental footprints. As technology continues to advance, prospects include improved efficiency, extended driving ranges, and deeper integration with renewable energy sources. These vehicles also contribute to cleaner air and quieter streets, enhancing urban and rural environments by reducing air and noise pollution. Continued innovation in solar panel efficiency and battery technology is expected to further enhance the efficiency, affordability, and accessibility of solar-powered electric vehicles, solidifying their role as a clean and sustainable mode of transportation for the future.

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