A Comprehensive Review on the Transmission System of Electrical All-Terrain Vehicle

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Abstract. The purpose of this study is to explore the differences between the traditional or gasoline All-Terrain Vehicles (ATV) and the electrical ATVs. From the previous researches, it is evident in recent decades that electrical vehicles are environment-friendly and do not produce polluted gases to the environment. The research provides important insights about electrical vehicles and advantages over gasoline-powered ATVs. The paper highlights the use of electric motors with different types of batteries and strengths that make electrical ATVs highly effective as a “low performance” vehicle for simple activities. With the extensive literature review and comparative analysis, the paper indicates important findings that the transmission or the power drive system enhances the performance of the motor due to the use of a differential gearbox. The paper concludes that electric motor delivers better load resistance and effective performance.

1. Introduction

The increased use of electro mobility in recent times can be explained with the important aspects of climate change, scarce resources, economy, technology and society. The higher use of electronic motors for vehicles is recommended to reduce the emissions of CO2 and other harmful gases during operation. There are many advantages of electro mobility, firstly the electric motors used in the ATVs are quieter because the noise emissions are very low. ATVs can be bike, three-wheeler or four-wheeler usually with low pressure tires. In all these years, ATVs were available in the market as a full-sized gasoline-powered vehicle. Electric ATVs powered with lithium-ion batteries are available offering better torque and acceleration. Secondly, these electric vehicles do not emit harmful gases while operation. It is absolutely environment-friendly and safe.

Previous researches have made it evident that gasoline-powered ATVs are not fuel-efficient and generate high pollution. The electrically drive motors are highly efficient than internal combustion engines. The torque of an electronic motor is the maximum from a steady position. Electric ATVs offer high torque characteristics. To reach high rpm, it increases its revolutions and loses its torque. The maximum speed of the torque is near around 14,000 rpm. Unlike, internal combustion engines, an electric vehicle accelerates faster. A high voltage battery such as the lead-acid battery, nickel-cadmium battery, nickel-metal hydride battery, and lithium-ion battery can be easily charged at home. In the near future, where would be very scarce resources, the use of electric vehicles can bring a revolutionary change in the countries worldwide. The supply of energy is done only when it is needed. If the traditional vehicles are compared, more energy is saved in road signals and traffic congestions by making the electrical motor ideal. An electronic motor has an advantage of a reduction gearbox and requires no lubricating oil.
2. Electronic Motor

An electronic motor is also known as an alternator or a starter. When an electronic motor receives an electric current, it works as a driving force. The electric motors used to create force are to be water-cooled. In the case of full hybrid vehicles, the electric motor is used as a starter for combustion engines. Bicek et al. [1] has reported the recent developments in electro mobility are that today the electronic magnetic parts manufactured to high attributes such as adequate torque density, low friction noise, vibration reduction, etc. An electric motor used in electronic vehicles offers maximum torque from its start. In comparison to traditional vehicles, the electric motor does not need an initiation phase to reach an idle speed. Spanoudakis et al. [2] explained that the torque is an imperative aspect of an electric motor. In an electrical vehicle, maximum torque can be achieved with a ceased or relatively low-speed vehicle. An electric vehicle is connected to driving wheels with the use of a single gear ratio. To meet the designing aspects, the authors proposed multiple gearboxes as a solution to increases the torque and achieve high performance and road grade. A multiple transmission system offers great benefits to achieve a green environment as it provides energy consumption solutions.

3. Strength of Electronic motor

Kumar et al. [3] examined and measured the drive wheel torque of a tractor by developing a mechatronic digital device. It was a simple and reliable device developed for the agricultural industry. The electronic motor is advantageous as it is environmentally friendly with negligible noise and emissions. The strength of the motor enables it to respond and accelerate quickly that makes it highly efficient in performance. An electric motor indicates the maximum torque at the lowest revolutions per minute (rpm) and drops only when the motor attains the highest speed. The findings indicate that the electronic motor does not require a clutch or a manually operated transmission or automatic operated transmission. Unlike traditional vehicles, the design of an electric motor is very simple with fewer parts. Hence, the strength of an electric vehicle is that it requires very low maintenance. An electrical motor can rotate both clockwise and anti-clockwise. The battery is the most important part of an electrical vehicle. The battery provides voltage to the powered vehicle. For an electrical vehicle, the term accumulator is used to define rechargeable batteries. The different types of rechargeable batteries are classified on the basis of lead-acid, nickel-cadmium, nickel-metal hydride, and lithium-ion batteries.

4. Transmission

Various authors have explored the performance of electric vehicles that are equipped with the mechanical transmission that divides the control of the power train into two which is the upper controller and lower controller. Ye et al. [4] observed from the deep literature review that energy-based power trains are focussing on an automatic mechanical transmission system having no clutch for dynamic coordination. Electrical vehicles are not dependent upon traditional transmission systems at different speeds. With the rotation of the vehicle, the electronic motor also changes. The positions such as neutral, reverse, and forward are in-built with the assistance of the gear selector lever. An electric vehicle delivers efficient performance with at least one electronic motor. Several hybrid models are possible such as a four-wheeler with one axle. Usually, the based on the requirement the drive with electric motor can be Drive with in-wheel motors or Drive with just one electric drive motor in the central drive train. The number of drive and placement of drive in the vehicle plays a vital role in traction, dynamic stability, durability and load carrying capacity.

5. Power drive system
The differential is an integral part of a four-wheeled vehicle. The ultimate objective of a differential is to allow the drive wheels to move at different speeds seeking power from the engine. The differential allows the wheels to turn at different RPM and gives power to the wheels. The function of a differential is also to reduce speed in case of high gear ratio and also turn the power flow by 90 degrees. In an electric vehicle, based on the placement of the electric motor the torque will be controlled by software, i.e. motor control unit. In order to increase efficiency and performance, the motor position are changed to observe various findings in many research works. But, works were not carried out in testing the electric motor in the traditional transmission system to observe its response on different parameters such as high rpm or low rpm. Two cases must being tested, if the traditional transmission systems achieve the highest rpm, the model focuses to increase the efficiency of the system. Secondly, if high rpm is not achieved, the model would focus on making changes to the system. Some problems may arise such as the efficiency may be low due to overlapping of the gears that are due to high rpm the motor. Due to high rpm, break shaft can break while turning.

Felden et al. [5] explained how the research of electronic vehicles has increased with time. Hereby the concept of drive train has become more challenging. Several models of drive trains were studied and it was found that electronic motor is one of the most important aspects to focus on efficiency and performance. Apart from the electronic motor, the transmission is a very important part to determine high performance. The analysis below compares the performance of power drive with multiple gearboxes with the performance of a power drive with a single gear. The paper attempts to study the impact of multispeed transmission on the electric vehicle in comparison to the impact of a single gearbox on the electric vehicle.

Chang Chih-Ming et al. [6] analysed the power performance with a 5-speed transmission or 1 single-ratio gearbox considering the tire radius, rolling resistance coefficient, air drag coefficient, front area and weight as the basic vehicle specification. In their work, 10kW BLDC was selected as Traction motors and achieved 48Nm rated torque, 125Nm peak torque and 3000 rpm maximum rotate speed. The work also resulted the maximum speed of 50 Km/h in single gear box and 70 Km/h in 5-speed transmission with wide range of acceleration ability. The performance of the electric vehicle with 5-speed transmission is better than with a single gearbox.

6. Conclusion

With extensive literature review the paper brings out important insights on the use of different gear ratios and its impact on the performance of the motor. The various model tested indicates that the transmission with a differential gearbox enhances the performance of an electronic motor in electric ATVs. The paper concludes that an electric vehicle equipped with transmission delivers better load resistance, unlike a single gearbox. So, the electric motor performance is enhanced with minimum power requirements.

7. References

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