Design of Transmission system Layout for an Agriculture
Electrical All-Terrain Vehicle

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Abstract. Tractors are consequential mechanical support in the agricultural field. They break down and authoritative mandates repair components, implementations, and cognizance on how to effect the rehabilitation. They require routine maintenance and clean fuel (fossil fuels or bio-diesel) and cause air pollution and infelicitous disposal leads to contamination of groundwater. The paper explains the design and development of a new transmission system of an electrical ATV (all-terrain vehicles) to satisfies the desiderata in the agriculture sector and to brief the parameters that are to be considered in the development of the new transmission system layout. This paper discusses the motor situating and the selection of the drive layout which satisfies the needs in the agriculture sector and also other necessary factors.

1. Introduction

ATV is a vehicle that can be driven in all kinds of terrain with one or two passengers carrying capacity and steering to control the vehicle. In the agricultural sector, there are different kinds of terrains like wetland, dry land, slipper land, and so on. In previous ATVs developed, the design was developed such that it allows transmission of torque to the wheel but this ATV was designed particularly for the agriculture purpose and hence it is necessary to develop a transmission system that satisfies torque transmission to the wheels as well as the driving of the agricultural accessories. To fulfill the objective it is very important to select a suitable drive layout and impose on proper placement of the motor. It is also very important to discuss the placement of the motor because it serves as the main source for torque generation in ATV. So we have to determine and properly place the motor such that it balances the vehicle as well as increase the efficiency of the transmission system in the vehicle. The choice of drive layout whether it is four-wheel drive or ais also important. If a two-wheel drive is chosen, further it is required sort and finalizes whether it should be a front-wheel drive or rear-wheel drive both has its features but it is very important to choose which will satisfy the need.

Placement of the motor

When we say that the motor is mid placed, it means that it is situated in between the rear and front axles of the automobile. However, its name can be misleading as the motor is not placed in the center but near the rear side. The position is such that the center gravity falls between the rear end and front end.

This positioning can be deliberated as ideal since it enables somewhat equal weight distribution. Consequently, the center of gravity is improved, ensuring stability. The preference for such a motor is important sports cars where speed and traction are most required.

The stability is achieved by the even distribution of weight which is achieved by placing the motor in near to the middle position as possible. Since the motor is the heaviest part, its placement ensures a balance while driving, the center of gravity's position enhances traction. Another advantage is that it is ideal for handling due to great traction, the traction prevents the possibility of skidding while breaks are pressed.
In our design, the mid-motor puts the weight on the rear tires and provides greater traction. Additionally, the anti-lock braking system’s efficiency is enhanced, conjuring prompt braking. The handling becomes superior since the inertia is reduced and the system becomes responsive, allowing fluid and speedy drive. Moreover, this layout makes a smooth ride possible by enhancing the suspension which absorbs the bumps on road.

This layout, however, has few limitations. Firstly due to the movement inertia around the COG is low, losing control can be detrimental. The automobile can start spinning and the lowered inertia makes handling the situation tricky. Nevertheless, conjuring such a circumstance is not easy.

Secondly, as the placement of the motor is near the rear side, the cabin space is compromised. The placement can make it hard to maintain the motor and it can hinder accessibility. Further, the placement of the motor makes venting heat out hard due to less airflow.

Automobile Drive Layouts

Automobile drive layouts can be categorized into two-wheel drives and four-wheel drives based on wheel power distribution or transmission of motor power. A 2WD drive layout is not only uncomplicated and lightweight but also copiously reliable to offer adequate traction on road, it is generally preferred when making a regular automobile.

Four Wheel Drive

A four-wheel drive also known as a 4WD has 4 wheels and propels the vehicle by powering all the 4 wheels. Thus it is also denoted by 4x4 denoting the number of wheels present and wheels powered by the motor. It can switch between a 4WD and 2WD as per convenience. The motor transmits the power to all 4 wheels via the axles, connected to it. At a time, each wheel of the axle receives the power and the powers are alternated between them in such a layout. It is ideal for offroading and for use in trucks, military vehicles, jeeps, etc since it is suitable for almost all terrain types.

The pros of this layout are that it maximizes torque transfer and enhances traction. It even offers a neutral steering experience. Due to this, the model becomes ideal for driving on low traction surfaces, rocky regions, steep hills, etc. Additionally, it gives the driver the option of switching between a 2WD and 4WD as per requirements. However, the layout is not without the cons. The design makes the car bulky and hinders acceleration from increasing. Also, the wheels wear out sooner.[1]

Two Wheel Drive

A two-wheel-drive also known as 2WD, has 4 wheels whose propelling shaft only propel two wheels, generally, rear or front. 4x2, which symbolizes the number of wheels followed by the number of propelled wheels is often used to represent it. In short, a 2WD layout has 2 wheels spun by the transmission of motor power to move the vehicle.

These sets of wheels are mostly either the wheels at the front or the back i.e. the axle of the drivetrain. The power is alternated between the two wheels, i.e., only one wheel of the drivetrain would receive power at a time, depending on the situation’s demand.

Generally, for turning the vehicle, the 2wd layout has a Torsen differential in the rear axle. It is imperative since if both of the wheels turning at the same speed or rate, turning at a corner would be tricky and dangerous. Therefore, the inner wheel must go slower than the outer wheel.

The differential paves way for one wheel to turn at a slower and another faster during such times. In these situations, in reality, only a single wheel (the one which has to go faster) receives the power or thrust. This differential also protects the wheels from wear and tear. The differential will be discussed in more detail in the latter part of the paper.
The 2WD is preferred as it is cheaper and easier to make. Additionally, the layout produces a lighter product and is also more fuel-efficient than other wheel drives. However, one must be careful when driving a 2WD since it is not suitable for all types of terrain. Nevertheless, a rear-wheel-drive can help to overcome this to an extent.[4]

**Rear Wheel Drive (RWD)**

A rear-wheel-drive (RWD) has a typical transmission system where the power of the motor propels the rear wheels in a 2wd. A classic RWD arrangement entails a transmission system which is attached to the motor in front (FR layout), through which the power is transmitted to via a driveshaft to the rear axle, propelling the rear wheels. This ensures an even weight distribution. Since it’s a 2WD, traction, stability, and handling are superior. This also means that there is even weight distribution, no torque steer, and a better braking system. Conversely, it inherits a few disadvantages of 2WD.

These are less interior space and risk of uncontrollable instability. Additionally, this version of the 2WD can be costly and incur the loss of efficiency. However, this design was chosen for a myriad of reasons. Firstly, in a 2WD acceleration is enhanced with balance and traction in a rear-wheel drive, as the weight tends to move on the rear wheels. Secondly, as aforementioned, the handling and stability of the drive are ensured as a result of weight balance.[1].

**THE NEWLY DEVELOPED DESIGN OF TRANSMISSION SYSTEM FOR AGRICULTURE PURPOSES**

![Diagram of the newly developed transmission system for agriculture purposes.](image)

**Abbreviations**

- P1=Pulley-1, P2=Pulley-2, P3=Pulley-3, P4=Pulley-4, P5=Pulley-5
- BR1=Bearing-1
BR2=Bearing-2

The new transmission unit design will satisfy the purpose in the agriculture sector in such a way it can drive agriculture accessories with a single power unit, a motor. The differential gear is made up of aluminum alloy as they are light in weight and have less stress value at differing high and low speeds. The propeller shaft material was into structural steel that improves the efficiency of the transmission layout. This layout is more suitable for dry and semi-wet agricultural lands. The pulleys are used to rotate or drive the agriculture accessories which can be customized according to the pulley rotation and the rotation of the pulley. The pulleys are made up of plastic as they are light in weight and are available at affordable prices. They can easily be maintained, removed and are tolerable to the environment.

2. Conclusion

The medial placement of the motor has similar advantages as that of the engine and rear-wheel drive which helps to build the transmission system of an electrical ATV. This improves traction avoiding a skid when brakes are applied and thus provides a smooth ride and improve stability. It enables effective usage of designed ATV in the agricultural sector. The new design uses structural steel and makes it a more suitable mechanical design for the agricultural sector. The proper positioning of the motor improves the efficiency of the transmission system layout. The design is cost-effective since the end effector can be customized according to the requirement. The pulleys are made of plastic which makes it available at affordable prices. The summed up design will aid the agricultural sector with greater efficiency and will also reduce environmental pollution.

3. References

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