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## MODELING AND IMPLEMENTATION OF REGENERATIVE BRAKING SYSTEM IN A HYBRID AUTO RICKSHAW

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### Abstract:

In upcoming knowledge progress, the vehicle seems to be hybridization i.e. vehicle with two sources (Electric and petrol) for the drive train. In this paper, we are going to deal with regenerative braking of BLDC motor in the three-wheeled solar hybrid auto rickshaw. In the design of auto rickshaw, the vital components are (motor, solar panel, battery, and Engine) generally the auto rickshaw is utilized for commercial transportation purpose in India. When you step on your car brake, you're wasting energy.

Physics tells us that power cannot be destroyed. So after your car slows down, the kinetic power that was propelling it onward has to go somewhere. Most of it plainly dissipates as heat and becomes useless. That power might have been utilized to do work. This paper debates how to change the kinetic power into the Electrical one that can be recharged to the battery.

Thus, both the Electrical brake and power regeneration are achieved. In this hybrid auto rickshaw, we are going to combine the petrol engine and motor. When we use petrol engine then the motor will act like a dynamo and it will charge the battery.

### Introduction

In India, auto rickshaws are usually utilized as taxis, as they are extremely inexpensive to operate. Although the seeming advantages in the vehicle design, auto rickshaws present huge pollution problems in major Indian cities. This is due to the use of an inefficient engine, normally a 2 or 4 stroke, with nearly no pollution control. This paper presents a transportation arrangement established on auto rickshaws that work in an environmentally friendly way. As all new constituents in a hybrid vehicle hold extra weight, complexity, and price to the arrangement, defining the level of

hybridization and estimating the investment is the important part in the hybridization of auto rickshaw. Electric trains, cars, and other electric vehicles are powered by electric motors connected to batteries. When we're driving along, energy flows from the batteries to the motors, turning the wheels and providing us with the kinetic energy we need to move.

When we stop and hit the brakes, the whole process goes into reverse: electronic circuits cut the power to the motors.

Now, our kinetic energy and momentum make the wheels turn the motors, so the motors work like generators and start producing electricity instead of consuming it. Power flows back from these motor-generators to the batteries, charging them up.

The main goal of this proposition is to make the continuing Auto Rickshaw extra efficient through the use of an affordable add-on hybrid system. Hybrid mechanical battery propulsion technology is being promoted as extra price competent, extra reliable and extra power efficient than standard petrol and supplementary alternative fuel options for a standard vehicle, a significant amount of energy is consumed in urban driving cycles by braking. To enhance the performance of electrical vehicles, the regenerative braking arrangement has been developed. It utilizes the electric motor, providing negative torque to the driven wheels and converting kinetic energy to electrical energy for recharging the battery or power supply.

The control strategy of the auto rickshaw can be classified into two types

- 1) The control strategy that the vehicle is driven generally by battery energy. The vehicle has a long scope of pure battery driving. The motor has to satisfy the necessity of the power to drive the vehicle individually. The battery will be charged across solar panel.
- 2) The combination control strategy that the vehicle is driven generally by the engine and the battery power and the motor is auxiliary. The vehicle has slight pure electric mileage by the motor and the steering power is generally from fuel and the engine is the main manipulation for it.

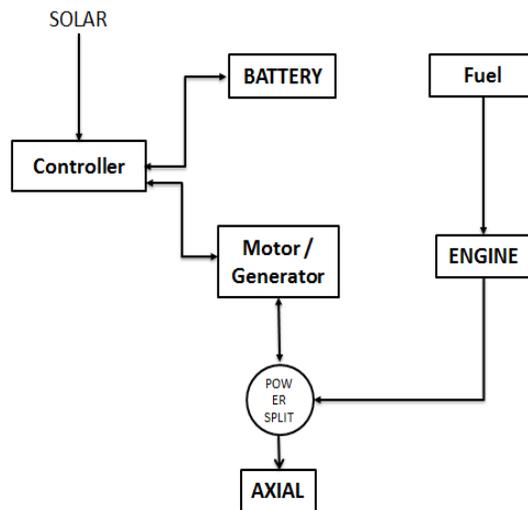
The regenerative braking does not work in all periods, e.g., after the battery is fully charged, braking needs to be effected by dissipating the power in a resistive load. Therefore, the mechanical brake in the EV is yet needed. EVs use the mechanical brake to raise the friction of wheel for the deceleration purpose. However, from the viewpoint of saving power, the mechanical brake dissipates far power as the EV's kinetic power is modified into the thermal one. In think of this, this paper debates how to change the kinetic power into the mechanical one that can be recharged to the battery.

Thus, both the mechanical brake and power regeneration are attained A mechanical brake arrangement is additionally extremely vital for EVs’ protection and supplementary procedures.

There are two methods to coordinate the regenerative torque of the motor and the friction torque of the hydraulic unit: parallel and series In parallel braking, the regenerative torque of the motor is exerted on the steering axle undeviatingly in supplement to the friction torque, as series braking allows independent modulation of the hydraulic brake torque of every single axle according to the regenerative torque,

**Table-1. Specification of Auto.**

Engine type	145.45cc
Max Power	6.6Kw @5000rpm
Max Torque	15.5 NM @3000rpm
Gears	4 FW + 1Rev
Clutch	Wet multidisc type
Seating capacity	Driver + 3 Passengers
Kerb weight	307kg
Dimensions	2635*1300*1692mm
Wheel Base	2000mm



**Fig 1. Block Diagram of Hybrid Auto rickshaw.**

In the proposed system the two driver circuits are there one is the motor and the other one is I.C Engine when the fuel Engine drive mode is used then the BLDC motor acts as a generator then the battery gets charged through the BLDC motor, therefore, the battery gets charged through the two sources solar and the BLDC motor. At the time of I.C Engine is used also we will get the DC power source through the battery.



**Fig 2. Proposed model of Hybrid Auto Rickshaw.**

## **Driver Circuit**

The Hybrid vehicle consists of a BLDC motor, Battery, speed controller as an Electric Drive and the Internal Combustion Engine with the transmission as known as Electric Drive.

## **Components and specifications of Electric drive**

### **1. BLDC Motor**

The BLDC motor has all the characteristics of the dc motor. It is in small size but it can give high torque at low speed and speed range can be easily customized.

### **Specification of BLDC Motor**

Power Rating: 1.2 kW

Voltage Rating: 48 V

Current Rating: 25 A

Torque: 23 Nm

Speed: 3500 rpm

Maximum Load: 1250kg

### **2. Battery**

Battery is device that consists of Electrochemical cells and used for storage purpose .in this Project we have used four 12 Volts Battery for to run BLDC motor.

### **Design of Hybrid vehicle with regenerative braking:**

The Basic design of hybrid vehicle consists of two sources i.e. DC power Source through Battery and Fuel source for internal combustion Engine. The battery is connected to BLDC motor



**Fig 3. Driver model of Hybrid Vehicle.**

The motor and I.C Engine both are connected to the rear wheel of the Auto Rickshaw through Axial as the motor rotates the attached wheel also rotates and thus leading the vehicle motion. When there is DC power source in Battery this mode of propulsion is used i.e. Electric motor is used. The next Phase consists of internal combustion Engine that moves the piston continuously. The controller is designed to implement the regenerative braking mechanism that the vehicle is running in IC engine means, the BLDC motor which is coupled directly will act as a generator.

#### **Advantages of Regenerative braking in a hybrid auto rickshaw**

It reduces the extreme dependence on the fuel which is a non-renewable source of energy and therefore it emits less greenhouse gas thus the problem of environmental pollution can be reduced. The modes of operations have maximum efficiency in some conditions i.e. when there is no charge in the battery we can switch to IC Engine (Switching from Electric Drive to Mechanical Drive), while the vehicle is running in Mechanical drive and that the battery will get charge through BLDC Motor, because of it will act like a generator. Due to these advantages, the regenerative braking can be achieved in the hybrid vehicle and makes superior to the other vehicle. On considering the drive cycle of the countries like India, the speed of the vehicle should be in a limit. So that the regenerative braking will not be a restriction to the vehicle operation.

#### **Conclusion**

Hybrid auto Rickshaw that uses two power sources i.e. fuel and battery. For lower battery power application, mechanical drive is used and for high battery power application electric drive is used. Thus hybrid auto rickshaw in both modes of operations will give its maximum Efficiency. Thus it gives twice the mileage given by a normal vehicle. It is most efficient in urban areas so the fuel consumption is reduced and it is eco-friendly. And the added advantage of regenerative braking makes performance much more efficient and its very suitable for urban drive cycle.

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